$4.00 per Year AUGUST 5, 1909. Price 10 Cents.

# AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

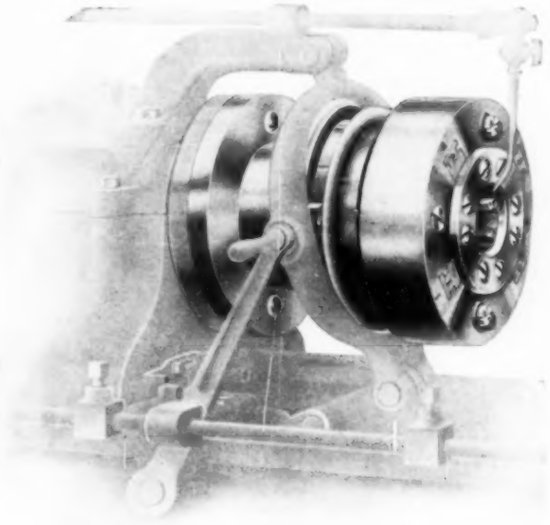
Vol. 32. 505 PEARL STREET, NEW YORK. No. 31.

Index to Advertisers and Classified Index Following Reading Matter.

PUBLIC LIBRARY OF THE CITY OF DETROIT

AUG 5 190

## Tell Us the Ailments of Your Present Threader



USE THE NATIONAL OPEN DIE HEAD FOR THREAD ACCURACY

ARE you bothered with taper end-threads?

ARE you compelled to re-cut off-size bolts and continually "gauge" thread when large lots are cut, and re-adjust the Head to maintain "size"?

AND does lost motion in other parts of the Machine affect thread accuracy?

In other words, **are you securing threads that satisfy your wants and those of your customers on a basis that makes your Bolt Cutter a paying proposition?**

If not, would you be interested in "talking" new Bolt Cutter or re-equipping your present Machine with a new Head if it insured 100 per cent. better B. C. service than you are now securing?

**The National Bolt Cutter will do that, and give you a larger range in thread cutting besides, and a National Head on your present Machine will give you next-best results.** *The largest bolt manufacturer in the world is equipping his Threaders with the National Head,* and that's one reason why **you** should be interested.

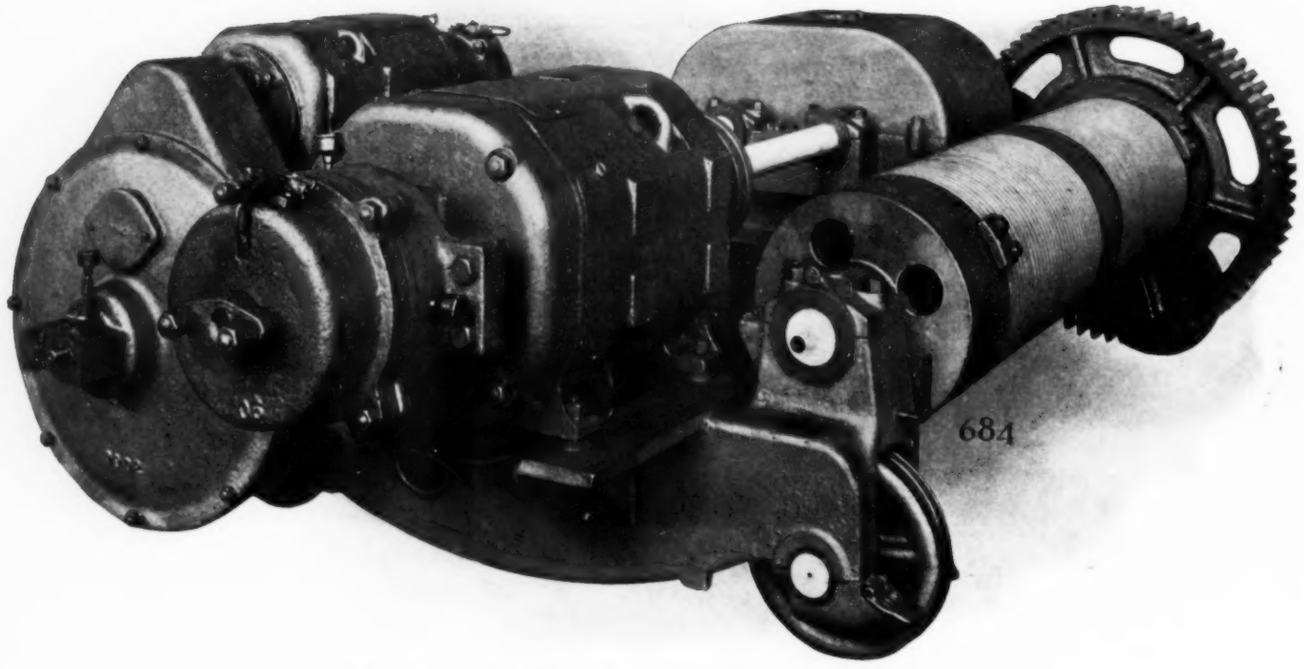
If we knew your needs, we'd tell you what's the cost to secure 100 per cent. bolt cutter efficiency.

Bulletins No. 10 on Single and No. 20 Multiple Spindle B. C.'s will be sent on receipt of your present address.

**The National Machinery Co.,**
**Tiffin, Ohio.**

TRADE THE NATIONAL MACHINERY CO TIFFIN OHIO U.S.A. MARK

# Quiet Running Without Jar or Rumble The Niles Electric Traveling Crane




Niles Standard Trolley. View from Main Hoisting Drum.

Gears are of steel and cut from the solid. No overhung gears. All gears, with exception of main and auxiliary hoist drum gears and pinions, are enclosed in cast iron cases and run in oil.

Hoisting drum is finished all over, and grooves are cut right- and left-hand, so as always to lift load vertically and without twisting. Shafts are of steel, turned and ground to size, and are extremely heavy. They are held in position by cap bearings, so as to permit the removal of any shaft without interfering with any other shaft.

*Write for Catalog "Niles Cranes."*

## NILES-BEMENT-POND COMPANY

**111 Broadway, New York. 23-25 Victoria St., London, S. W.**

OFFICES:

Boston: Oliver Bldg. Chicago: Commercial National Bank Bldg. Pittsburg: Frick Bldg. St. Louis: 516 North 3d St. Philadelphia: 21st and Callowhill Sts. Birmingham, Ala.: Brown-Marx Bldg. Agents: The Canadian Fairbanks Co., Ltd., Montreal, St John, Toronto, Winnipeg, Calgary and Vancouver. Agents for California, Nevada and Arizona: Harron, Rickard & McCone, 461 Market St., San Francisco, Cal., and 164-8 North Los Angeles St., Los Angeles, Cal. Ing. Ercole Vaghi, Milan, Italy. F. G. Kretschmer & Co., Frankfurt a.M., Germany. F. W. Horne, 70 C/- Yokohama, Japan.


(*See pages* 51, 52, 53, 54, 55, 56, 57 *and* 58)

# Inventing and Patenting—A Will 'o the Wisp

## Average Cost of a Patent $570, not $65. Less Than One in Four Pays Back Its Cost. The Novice Patentee Is Generally a Loser

BY L. P. ALFORD

Over 930,000 patents have been issued by the United States Patent Office. What has been their cost to the inventors to whom they were issued? How many have paid back their own cost? To what classes of inventors are issued patents that pay? Is it worth while to play the patent game? Answers to the foregoing questions are suggested in the following paragraphs within the limitations of the available data.

Yet at the outset this article is handicapped. If it should treat of the fortunes and fame that await the successful inventor and patentee; if it should describe the early struggles of well-known inventors and then enlarge upon their ultimate successes, beginning with a reference to the originator of the classic Bell telephone; if it should present a select schedule of inventions that the world is waiting for and is willing to pay for handsomely, beginning with a non-refillable bottle and ending with synthetical rubber, for which invention a popular magazine recently stated there is a standing offer of $4,000,000, then this article would be read with eagerness. For "men willingly believe that which they wish to believe."

But that side of the inventing and patenting situation in its general application is so unreal, so far from the average and so lamentably untrue that its presentation would be little better than the presenting of the shadow of a golden dream. Reality of fact is of more service than the unreality of dreams, even although "the suggester of a golden dream is preferred to the shatterer thereof." It is distinctively the purpose of this article to be of service.

### Statement of Purpose

For some years it has been my firm belief that the average patent costs much more in actual money, to say nothing of the patentee's time, worry and labor, than is generally supposed. (Patent solicitors' advertisements and pamphlets have created the impression that a patent costs about $65.) Also that very few patents ever pay for themselves and that the novice patentee, that is, the man who for the first or second or third time thinks that he has thought of something that is an invention and hurries to become a patentee, invariably loses everything that he invests in the shape of money, time and effort. With the purpose of showing the truth or falsity of these opinions, an investigation was undertaken by the editorial department of the AMERICAN MACHINIST.

It may be contended that the success or failure of an invention or patent should not be measured in dollars and cents; but from an acquaintance with many inventors, I firmly believe that the money motive is the motive from which the average patent springs and it is certainly the reward in money which the patent agencies place so alluringly before the inventor. Therefore, as the purpose of the invention and patent is to make money, it is perfectly logical to measure its primary success or failure by the amount that it brings. The common expression, "necessity is the mother of invention," implies a sordid motive and in no way suggests an inventor's high aim. If we change that expression to a less common but perhaps truer form, "necessity and laziness are the parents of invention" the purity of the motive is in no way increased.

### Letter Requesting Patent Information

A letter asking for information in regard to patents and containing eight definite questions was prepared. Following is the text of the letter and questions:

"Dear Sir:

"It is accepted as a fact that only a very few patents ever pay for themselves, yet no data have ever been presented to show the proportion existing between those that pay and those that do not pay. This proportion we wish to establish for the benefit of inventors and would-be inventors; to show what probable chances such an inventor has that his proposed invention will be a success.

"To this end we propose to analyze a large number of patents of about three years' standing. A patent of yours is among those that we have selected, and hence we send this letter to you, along with 5000 other patentees of about the same date.

"We hope for your coöperation in this investigation, which we expect will be of wide-spread interest, and are sending herewith a blank, which we trust you will fill out and return to us at your earliest convenience. Your reply will be considered confidential, and no disclosure of the facts will be made in the reading columns of the AMERICAN MACHINIST except in summary and percentage analysis.

"We take the liberty of thanking you in advance for your courtesy in filling out and returning the accompanying blank.

Yours very truly,
AMERICAN MACHINIST,
Editorial Department.

"Data concerning United States Patent No. .....
Issued.....to.....

"1 What do you estimate as the cost of your invention and patent (number given above) up to date of issuing the patent?..

"2 Has this patent been sold?.....

"3 Did the sale price reimburse you for the cost as shown by item 1?.....

"4 If you have not sold it, are you getting any return in money from the patent? .....

"5 Is the return indicated by item 4 sufficient to reimburse you for the cost of item 1? .....

"6 If the patent was assigned, did you receive any compensation other than a regular salary? .....

"7 If you have not received any money return from the patent, do you expect to receive such return soon? .....

"8 How many patents have been issued to you prior to the issuing of this one? ..

"9 Remarks....."

A copy of this letter was mailed to each of 5000 United States patentees residing in the United States and Canada. These 5000 patentees were taken successively, beginning with January 1, 1906. Thus each patent was about three years old. It was assumed that if it had not paid for itself in that length of time, it probably never would do so. An additional reason for not taking patents of greater age was the certainty that many patentees could not be reached through the mails owing to change of address. As a matter of fact, 772 letters were returned with a statement from the postoffice authorities that the addresses could not be located, or a little more than 15 per cent.

Turning to the questions; question 1 was framed to bring out the cost of both experimental work and patenting, questions 2 to 5, inclusive, were intended to draw out the fact as to whether or not the patent had returned a sum of money sufficient to cover its cost, as outlined by question 1, through direct sale or in some other manner. Question 6 covered the situation of returns from the patent provided it was assigned. As is well known, patents assigned to corporations in general have a compensation of $1 and other valuable considerations. The "other valuable considerations" are usually intangible. Question 7 was inserted to act as a check upon the assumption that an unsuccessful patent three years old will continue to be unsuccessful for life. While the answers to this question were not tabulated or analyzed in detail, their general tenor indicated the belief of the patentee that as the patent has been unsuccessful during the first three years of its life, it was

valueless. The eighth question was intended to draw out the distinction between the novice patentee and the professional patentee.

By far the most interesting part of the answers was contained under the heading "Remarks." Many of these statements were so pertinent that they will be quoted at length in this article. The latter part of the third paragraph of the letter states that the replies will be considered confidential. For that reason no names are quoted in connection with these statements and in every case the writer's permission was obtained prior to publication.

### Summary of Answers

The following is a summary of the results obtained from the circular letters:

Number of letters sent out, 5000.

Number of letters returned undelivered, 772.

Number of answers received, 622.

Number of answers containing usable data, 592.

Number of patents on which costs were given, 509.

Total cost of these 509 patents, $291,029.

Average cost per patent, $571.76.

Number of patents in regard to which data were given as to whether they had or had not paid, 586.

Number of patents that paid their cost by sale or otherwise, 117.

Number of patents that did not pay their cost, 400.

Number of patents granted to manufacturers or assigned for compensation, 21.

Number of patents assigned for no compensation, other than regular salary, 48.

Total number of patents that did not pay patentee, 448.

Total number of patents that paid, 138.

Percentage of patents that paid, to total (from last two items), 23.5 per cent.

Patents previously issued to assignors for no compensation: To 33 persons, 891 patents, an average of 27 per person.

Patents previously issued to assignors for compensation: To 15 persons, 188 patents, an average of 12+ per person.

Patents previously issued to patentees whose patents paid: To 108 persons, 1123 patents, an average of 10+ per person.

Patents previously issued to patentees whose patents have not paid: To 365 persons, 1492 patents, an average of 4.8+ per person.

Note. Of the above, 16 persons have 891 patents to their credit, leaving the majority of the unsuccessful patentees, 349 persons, with only 601 prior patents, an average of 1.7+ per person.

### Cost of United States Patents

In a preceding paragraph I mentioned that the popularly supposed cost of a patent is $65. This investigation shows that the average cost is nearly nine times that amount, or instead of the supposed $65, it is $570, and even this figure is too low. Many of the individual items that were averaged to obtain that figure were stated to cover only "government and attorney fees," or "actual money expended," or "I have made no account of my own time and labor." Thus while $570 is the result of our averaging and is the amount which I must present as the average cost of a United States patent, our investigation shows in unmistakable language that this amount is too small. How much too small I do not know. Yet this figure I would set before the novice patentee as one to keep clearly in mind when he begins to ask himself the question, "Can I afford to patent this idea?"

If we stop to consider the cost of patents issued per year in the United States, or for a decade, and apply the unit cost determined above, we reach some interesting sums. During the year 1906, 31,181 patents were issued, costing the patentees in round numbers, $17,800,000. During the decade 1897 to 1906 inclusive, 265,430 patents were issued aggregating a cost of some $151,700,000. The first patent in our present series was issued July 28, 1836. To June 1 of the present year, 923,129 patents have been issued. If any reader wishes to apply the unit cost, $570, to this total number of patents, the total cost thus figured will undoubtedly be startling.

### How Many Patents Pay?

The preceding summary gives us the percentage of 23 as the number of patents that have paid their cost; note, this does not imply a profit. The numbers from which this percentage is derived are 448 patents that did not pay their cost to the patentee and 138 that did pay such cost. In the group of 448 that did not pay, 48 patents were assigned without compensation other than the regular salary. A contention that these should be considered as paying patents is untenable from the fact that large corporations usually demand the assignment of inventions developed by employees in their regular service and if the employee obtains any returns whatever, through a slight increase in wages or in some other manner, he is fortunate indeed. Similarly the 21 patents which are classified as having paid, in that they were assigned for compensation other than a regular salary or were taken out by manufacturers themselves, are to a degree improperly placed for there is no certainty that a patent granted to a manufacturer ever pays for itself in any way whatever. Many firms inventory their patents at $1.

However, returning to the summary and brushing aside these two items of 48 patents and 21 patents, respectively, and working out a percentage of patents that paid to the total number from the figures 117 and 400, respectively, in regard to which the information is definite, we arrive at a percentage of 22.6, or approximately the 23 per cent that we are considering. Thus as far as the tabulated figures are concerned, the proportion of 23 patents that pay their cost to 77 patents that do not pay their cost is established accurately.

But, "successes are more willingly proclaimed than failures" and it is more than likely that the replies received to the circular letter have automatically established a higher percentage of successes than actually exists. In any event, if less than three out of ten patents pay their cost, to say nothing of a profit, the outlook before the novice patentee is far from bright, especially when he considers that real inventing is as much a fine art as painting or sculpture; as in those arts natural talent and experience count for success, so in inventing a creative genius trained by practice gives its possessor a tremendous advantage.

### Chances of the Novice Inventor

Not the least instructive of the tabulated data are those relating to patents previously issued. Thirty-three professional inventors, assigning without compensation other than regular salary, have to their credit an average of 27 prior patents each. Of patents assigned for compensation, 15 patentees have an average of 12 patents each issued prior to the ones concerning which data were asked. Similarly, of the patents that paid, the 108 patentees have to their credit an average of 10 prior patents each. These patentees are experienced men in the art of inventing and patenting as shown by the number of patents granted to each of them prior to the one which was investigated. The records show that they are professional inventors, not novice inventors, for each had to his credit from 11 to 28 patents.

How different is the situation of the patentees of the unsuccessful patents! Here 349 patentees have only 601 prior patents to their credit, or an average of 1.7. *That is to say, among this class of patentees—aggregating 349—whose average number of prior patents is 1.7—not one of the patents investigated has paid its own cost.* The fact that 16 other unsuccessful patentees had 891 prior patents, thus showing that they were professionals, merely proves the hazard of the game. The fact that a person is a professional inventor does not mean that every one of his inventions turns out as he expects.

The preceding paragraphs show that the average cost of a patent ($570) is some nine times the figure usually stated, that less than one out of every four patents pays its own cost, to say nothing about a profit, and now the novice patentee is brought face to face with facts that show that his chances of producing a successful invention are tremendously small. "To the victor belongs the spoils," and to the professional inventor are issued patents that pay.

### Quotations from Our Correspondents' Letters

The following are a few selected quotations taken from item 9, "Remarks," of the circular letter and touching on various phases of the patent situation. In keeping with our promise of confidence, the names of the correspondents are, of course, not given. All of these quotations are testimony from experience.

### Do Patents Pay?

A patentee having extensive knowledge of the subject states: "My experience is that only one patent out of every four proves profitable."

Others write: "I am of the opinion that at least 90 per cent. of the patents issued do not pay for themselves."

"Some of my patents have not paid their cost. I should estimate that 5 per cent. of patents issued would be a liberal estimate for those that have paid a profit to the inventor."

An inventor having 125 patents to his credit states: "I think, without looking up definite data, that one in ten of my patents has paid in the above sense. [That is has repaid its cost without reference to profit.]

"There are about 800 patents issued weekly and while more patents are possibly used today than ever before, I still think that scarcely one in ten returns its original cost to the inventor."

"I have paid out in actual cash more money than I have received in return on all my patents and my labor has been lost."

"Generally speaking, I do not believe one patent in a hundred is worth the paper it is printed on and in most cases where real value is involved, the inventor is the last one to profit thereby."

"I have sold all of my patents. If I had possessed a little capital, I could have made out well with them. Those who bought them have made money. I had to use them as pot boilers."

"If a man is poor, he better let patents alone. If he gets a good thing, the sharps will get it from him. If he gets a poor thing, he may have it. Once in a while a poor man slips through. With a lot of capital behind a good patent, as a scarecrow there is sometimes money in it, but the patent business has become so complicated that all a poor man can get out of it is a vision."

"I do not believe that patents as a rule are profitable except to professional inventors, and then only when the inventor is a good business man."

### Fake Patent Salesmen

The reprehensible business methods of fake patent salesmen are well known, yet these fakers continue to advertise largely in some channels and reap a harvest from the novice and uninformed patentee. The experiences of some of our correspondents with these bunco gentlemen is given in their own words.

"I wish to confess frankly that I have had my head bumped good and hard by people representing themselves as being able to dispose of patents. And so for the benefit of inexperienced inventors I advise the poor devils to fight shy of these wholly unreliable fake patent salesmen."

Note the accumulated disappointment in this short sentence: "I depended on fake sales agents for nearly two years."

Here are three quotations from as many letters all similar in tone. "I gave the sale of my patent to an agent in New York City for $25 down and 10 per cent. when sold. I wrote to him to see how he was getting along with the sale, when to my astonishment my letter came back refused. Now my patent lies as dead as a dog."

"I have received many letters from different companies to sell my patent and have given lots of money and not got any in return."

"Like a lot of others, I thought that after I had the patent, it would sell itself, but I found out differently. I dropped the matter after I found out that a lot of those attorneys who claimed to sell patents were humbugs."

The methods of these fake patent salesmen are disclosed to a certain extent by this bit of personal experience. "I received letters from all parts of the country and Canada from agents wanting to buy or sell my patents. Everyone demanded money from $25 down to a 2-cent stamp. One man wrote four times. The first time he wanted $25; the last time, a stamp; but not one ever made me an offer."

### Attitude of Many Corporations Toward Inventors

The way in which very many salaried inventors look upon the terms of their contracts is well expressed by this statement of one of their number: "Before entering the employment of most large corporations, you must sign a contract that you will assign all improvements or patents that are granted while in their employment. In other words, you must sell yourself, body, soul and spirit in order to get a job."

Here are four quotations which show how four inventors believe that the profits from patents are only for the corporation or men of money. "It pays to invent, but not for the inventors. The moneyed man gets all the profit."

"After 30 years of work on patented specialties, I am ready to say that patents are a delusion and a snare. Those that are of small value cost more than they are worth. Those of great value will be stolen by the barons of manufacture and commerce, and with practically no redress by process of law. I have drawn from ———— Company during the five years of my connection with them, several thousand dollars, which includes both salary and royalty. Since January 1 of this year I have been entirely forced out, and received no more income from my patents. The capitalists have it all for themselves now."

"Every man thinks he can steal a patent, which he does generally with impunity."

"The ———— Company have about nine of my patents. The machines which they now build rest on my patents; yet I am disgusted with patents and with inventions. My experience has been a sorry one."

The position of the individual inventor versus the corporation is thus seen by one man: "It is my firm belief that you cannot get a patent on anything that would interfere with a large incorporated company. Some of them have paid attorneys at Washington who watch for this, and they immediately start in to make it expensive for a poor man. Patents once granted should be defended by the Government. I was either forced to sell out or to be put to an expense that I could not stand."

The ultimate repressing effect of certain lines of inventing is here shown: "While working in a minor position I assigned my first patent thinking to benefit myself. After that many promises and a few salary raises got the rest. At the end of 20 years the other fellow is worth a million while I am still hoping, but not making any more assignments."

The attitude of railroad officials as one man has found it is: "Railway managers are not interested in any railway invention. They will not allow patent articles to be used until the patent runs out."

### Criticisms of Patent Procedure

The inefficiency of the Patent Office at Washington has been discussed at such length in the technical press that it only needs a mention here. The hardships of patent legal procedure, however, are not as well known except to actual inventors. This legal procedure is the first point which should be attacked by a united effort among American inventors, in order to bring about such changes that they may be relieved from the hardships that they now endure. Five of our correspondents touch upon this phase of the patent situation.

"Plainly speaking, I consider the Patent Office a farce. Examiners are not competent. In my mind, there is not sufficient protection given by the Government after it has taken your money and granted to you a patent."

"The patent laws of this country are very poor. Patents can be secured on any old thing, and the patent serves no good purpose unless it has been tested in court. I think that the patent laws should be so changed that examiners granting a patent on an invention should be final, and not permit of costly litigation to the inventor for fancied infringement."

"I have been granted over fifty patents, and am well convinced that Uncle Sam's patent office game is a 'gold brick,' as the courts easily set aside many of the patents

that come before them, making the inventor afraid to place confidence in his Government."

"The average patentee has a most vague idea concerning the validity of his patents. He knows but little of existing art as covered by prior patents and feels quite certain that a combination claim gives him full protection and prevents anybody from making a machine like his. Last year I made a personal search at Washington and discovered six patents that antedated by 5 to 25 years a recent American patent, and the office had no knowledge of them. In fact, the office has comparatively little knowledge of prior patents. I would not spend much money on inventions until I had made a careful personal search in Washington. I question if professional patent searchers are careful or thorough in their investigations. Certainly this has been my experience."

GENERAL TESTIMONY FROM INVENTORS

"I consider patents as now issued simply a license for a lawsuit."

"I consider patents of no use except to manufacturers to protect an improvement in their product."

"Inventions pay only when the market demands them. A man seldom makes anything out of his patent unless he manufactures it himself, or is connected with a company which pays him an adequate salary. Discourage promiscuous inventing."

"I paid $100 to get free of the big head."

"Oh, yes; each one of my patents promised to make a bloated bondholder of me until I placed them all on the shelf."

"In my opinion patents are comparable with other enterprises as to financial yield, and the commercial skill used in development has fully as much to do with the success as ingenuity of the inventor."

"I have spent about $1500 on patents, all charged to experience."

"Patents are like many other things in this life, 'it is necessary to work your wings to fly.'"

## Drawing

Drawing is a pristine art,
If sacred history's true,
For who's not traced the details
Of the first breath Adam drew?

Drawing is a noble art,
For kings and knights and lords
Took pleasure oft in drawing blood,
And corks and trusty swords.

Drawing often occupied
The men of ancient fame.
Old Cicero could draw a crowd,
And Cæsar oft drew rein.

Drawing, at the present time,
Invades each walk of life.
The dentist draws an aching tooth,
The bandit draws a knife.

A lucky person draws a prize,
A lawyer draws a fee,
But what we all draw least, perhaps,
Is ample salary.

S. A. M.

## Diagram for Crank Shaft and Tool Positions on Double Acting Press

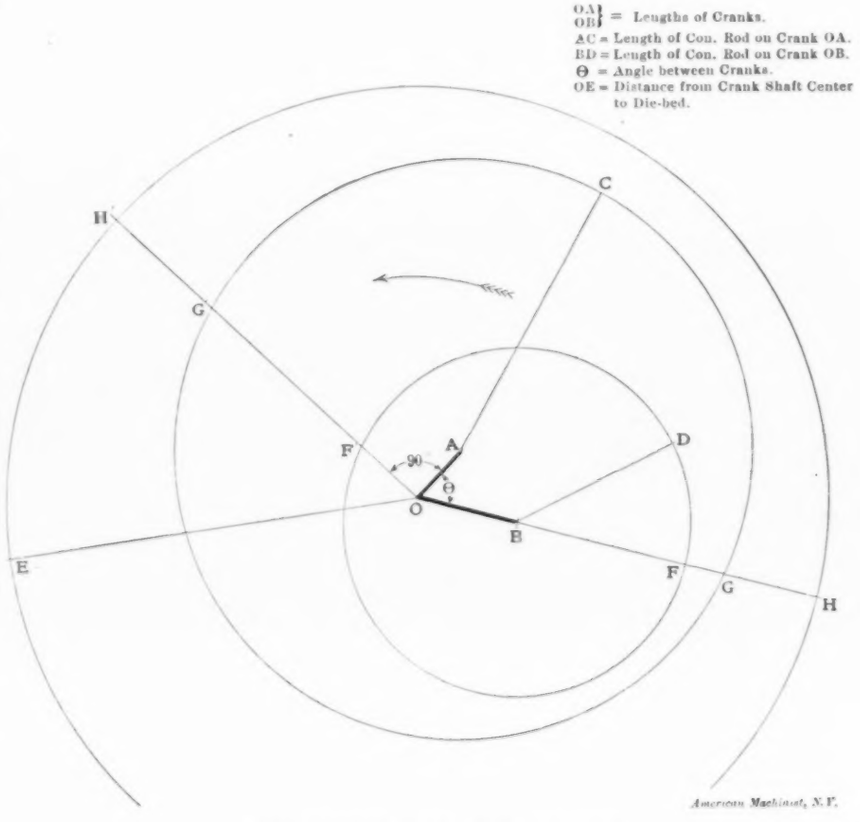
BY J. J. DENSMAN

The accompanying diagram may be found useful by anyone designing tools for double-acting crank presses, saving tedious manipulation of pieces of tracing paper and insuring accuracy.

From $O$ draw lines $OA$ and $OB$ to a convenient scale representing the lengths of the press cranks and at the same angle to each other as the press cranks. From $A$ and $B$ draw circles with radii equal to the length of the connecting rod on cranks $OA$ and $OB$, respectively. From $O$ draw a circle with radius equal to the distance from the crank-shaft center to the die bed of the machine.

With due regard to direction of rotation, proper allowance for the lengths of crossheads and hight of die block, the relative positions of punches and die for any angular position of crank shaft can instantly be obtained, by drawing a line through $O$ representing the vertical center line of the machine.

Thus, $FG$ represents the distance with aforesaid allowances between punches when crank $OB$ is at the bottom of the stroke, and $GH$ represents the distance between die and punch controlled by crank $OA$. Similarly $F'G'$ and $G'H'$ represent these distances when crank $OA$ has advanced 90 degrees from its top position.




DOUBLE-ACTING CRANK PRESS DIAGRAM

In a discussion appearing in the *Railroad Age Gazette* dealing with the subject of protective coatings for iron and steel, a writer states that while linseed oil is the best material that can be used for this purpose, it is not by any means perfect, because the modern linseed oil contains a much larger percentage of impurities than is generally supposed. These impurities being fatty and non-drying in their nature make the coat of oil when applied to the iron very weak and subject to abrasion. They also, on account of their solubility in water, allow easy access to water, which, when it is once under the very tender, weak coat, will very readily tear comparatively large openings in it, allowing the introduction of destructive agents; and where a real solution of the problem is wanted these impurities must be taken out of the oil in order that a perfectly soluble, inert film, fit not only for the temporary protection of the iron, but also fit to hold the future coats of paint, may be attained, and it is perhaps apt to say that there has been very much less attention paid to the removal of deleterious impurities from linseed oil than the subject deserves.

# Operations in Building and Inspecting Lathes

## How the Hendey Machine Company Planes, Scrapes and Tests the Beds, Heads, Saddles and Other Members of Its Engine Lathes

## EDITORIAL CORRESPONDENCE

In the building of the Hendey-Norton lathe at the shops of the Hendey Machine Company, Torrington, Conn., many methods and devices are used which should be of interest to AMERICAN MACHINIST readers. From the moment the rough castings are received in the planer department until the lathe is completed ready for shipment, the series of operations carried on, including planing, scraping, assembling, testing, etc., is a most instructive one to the visiting mechanic. Some of these processes and a number of devices by which they are facilitated are illustrated by the accompanying engravings.

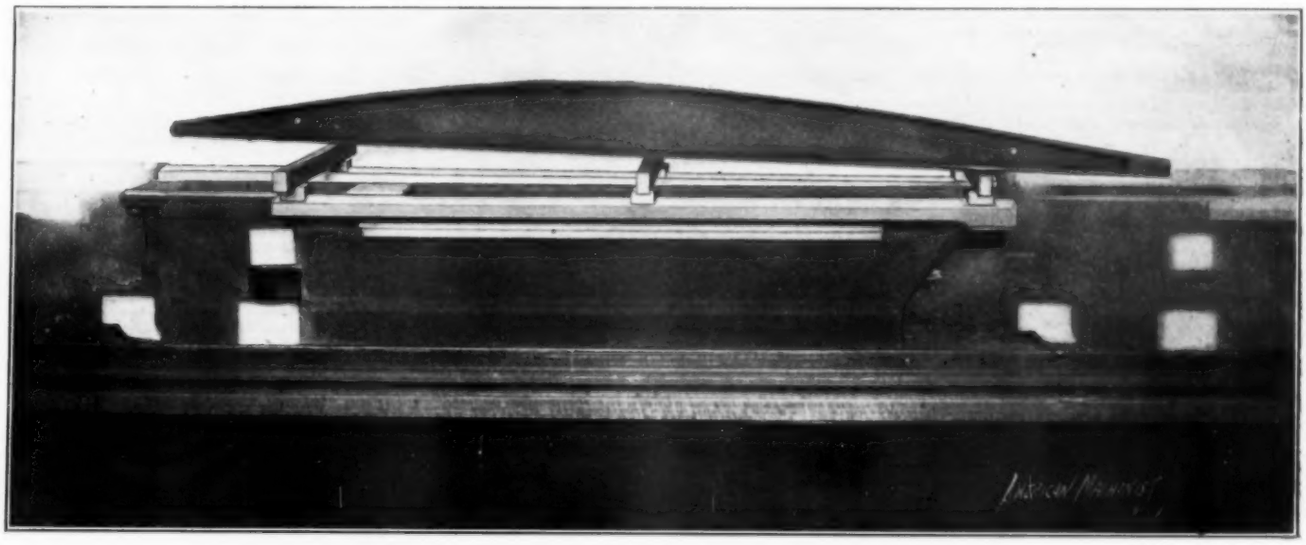


FIG. 1. TESTING LATHE BEDS ON THE PLANER TABLE

### PLANING LATHE BEDS

The rough lathe beds as they are brought into the shop from the castings storage, where they have been permitted to "season" for some little time, are placed on the long platen of a Gray planer, six or eight beds being strapped at a time in two rows on the planer. The beds thus handled in strings are not necessarily of the same length; that is, there may be on the planer at one setting a number of six-foot, eight-foot and other lengths of beds. So long as they are for the same swing of lathe and of uniform section, inequality of length is immaterial. The beds are first strapped down bottom side up, and the four heads of the planer utilized simultaneously for roughing out the bottoms and side pads of the two rows of beds. After easing up the straps finishing cuts are taken and the work is then turned over and the V's, the front and back edges, rack seat and other surfaces near the top, roughed out and finished. In setting the beds for the planing of the ways, the truth of the planed bottom of the beds is tested by resting the work on pieces of tissue paper. The straps are, of course, eased up so as to grip very lightly for the finishing cut and thus avoid any possible distortion from this source.

It is customary in some shops when planing lathe beds, to rough out the casting all over, then finish, this method involving several settings of the work. Mr. Norton states that this practice has been found unnecessary in their own experience as the beds have exhibited little or no tendency toward distortion when planed in the way described, with two settings only. However, in order that, should any possible distortion occur in any individual bed, this may be detected before the bed leaves the planer and unnecessary work in scraping be avoided, each bed is tested with a straight-edge, as in Fig. 1.

### INSPECTING WORK IN THE PLANER

For this test the planer straps are removed, three pairs of V-blocks are placed on the outer V's of the lathe and on these three parallels are rested to receive the straight-edge. The latter is placed parallel with the V's and then slewed around to test the V's obliquely from corner to corner. If the straight-edge when in either position fails to bear equally hard on the three parallels, the fact is readily discovered, either by tissue-paper test, or by rocking the straight-edge, or swinging the parallels to and fro under it. Should sufficient irregularity be discovered in this test to make it advisable to take another cut over the top of the lathe bed this could be readily done as the position of the work on the platen is not disturbed and the holding-down straps could be easily applied again. Such additional cuts, however, have seldom been found necessary. In fact, the mere provision for this test for each and every bed before it leaves the planer, is an important factor in assuring careful and accurate results in planing.

For each size of lathe bed there is a master templet conforming in outline to a cross-section through the top of the bed and by means of which the planer tools are set for taking the various cuts. The usual sheet-steel gages or templets are also made use of for testing the form of the V's, their positions relative to each other, the hight of the flat front way compared with the V's, etc. In short, due care is taken in all particulars to insure correct planing and so render unnecessary an excessive amount of scraping. It may be stated that the planers on this work operate at 50 feet per minute cutting speed. This rate was adopted only after considerable experimenting at various speed and having been found satisfactory is now used on practically all

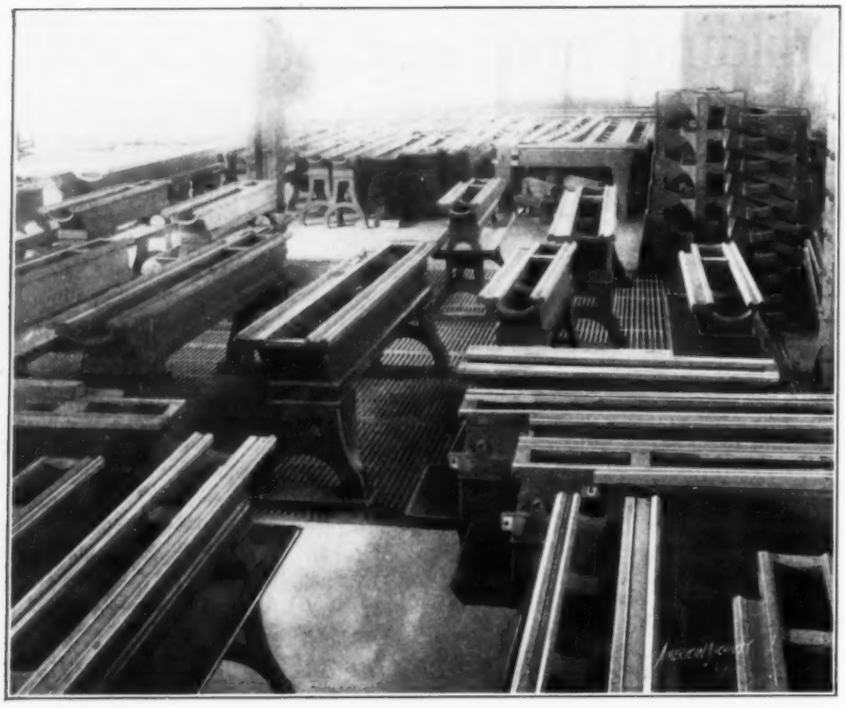


FIG. 2. GRATING ON WHICH LATHE BEDS ARE RUBBED DOWN AND PREPARED FOR SCRAPING

planers at the Hendey shops operating upon this class of work.

After the lathe beds have been bolted on their legs they are taken to another department and placed on a grating for rubbing down, filling, etc. The view in Fig. 2 illustrates the section of the shop used for this purpose. The iron gratings as shown extend over a considerable area and a number of lathe beds may be placed here at the same time. Between this rack floor and the ground below there is an air space of some depth and all dust caused by rubbing down the sides of the castings is drawn down through the openings in the gratings, thus preventing accumulation of dirt on the floor and leaving the air in this department practically free from dust.

### Scraping Lathe V's

Before scraping operations are started the lathe is carefully leveled up as in Fig. 3, then the surfaces of the V's are gone over quickly with a scraper to remove the planer-tool marks. After this rough scraping the inner V and the flat way at the front for the headstock and footstock are scraped true to a straight-edge and to a master fixture representing the bottom of the headstock, and a dummy head as shown in Fig. 4 is bolted on in the same way as the real headstock will be attached later. The scraping of the outer or carriage ways is now proceeded with under the same conditions as would obtain were the headstock itself bolted down to the bed.

Figs. 5 and 6 illustrate the application of the straight-edge in testing the V's as the scraping is carried on. The three pairs of V-blocks shown resting on the ways are finished perfectly true and to uniform hight as are also the three parallels which rest upon them and across which the straight-edge is placed. The straight-edge is applied approximately parallel with the lathes shown and also swung at an angle to the front and back of the bed. Tissue paper may be used under the straight-edge at the three bearing points to determine if it rests equally on all three parallels, or the thumb and forefinger can be applied to the end of each parallel in turn to determine this point. Furthermore, and especially when the straight-edge is swung toward either the front or back, if the tops of the three parallels are not exactly in the same plane the straight-edge will rock on the middle parallel, or rest on the two outer ones and clear the middle one; in either event the discrepancy is readily discovered by the man handling the straight-edge.

Each V is scraped true and straight, the

FIG. 3. LEVELING THE BED

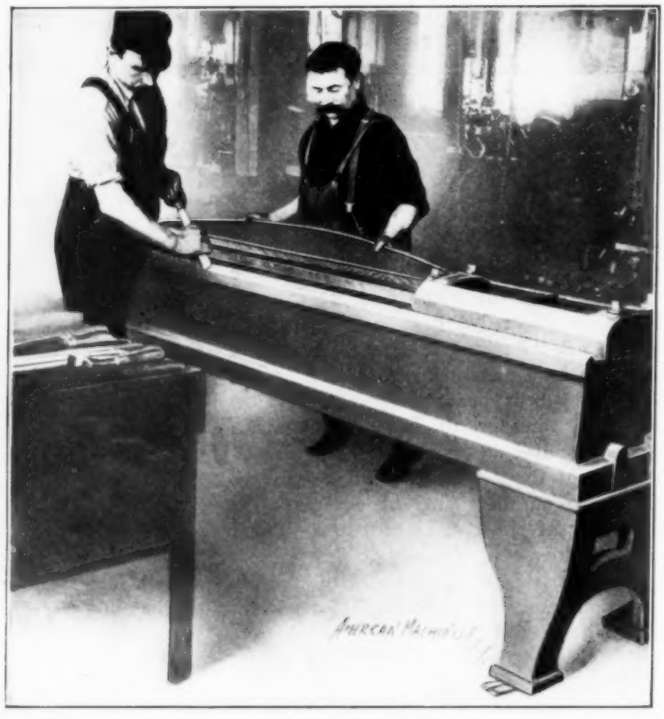


FIG. 4. ROUGH SCRAPING THE V'S

FIG. 5

FIG. 6

TESTING WITH STRAIGHT-EDGE

workman applying a straight-edge, coated with red lead, along the surface and marking the high spots; then the saddle and bed V's are scraped together for a proper bearing, the V guides in the saddle being coated with marking material, which, as the carriage is slid to and fro along the bed, locates the high spots on the bed V's which require scraping down. When a good bearing surface is obtained the red coating used as a marking medium can be dispensed with, and, with the V's wiped with turpentine, the bright spots caused by sliding the saddle on the bed are used as a guide for the finish scraping operations. Fig. 7 illustrates the operation of scraping the saddle which is shown turned bottom up on a wood frame.

### Tests During Scraping

During the scraping of the saddle and bed V's to a proper bearing the latter are tested frequently as in Figs. 5 and 6 to insure their being kept straight and free from wind from end to end. Also they must be tested in reference to the inner or head- and foot-stock ways in order that parallelism between inner and outer ways may be secured. This test is accomplished as illustrated in Fig. 8 which shows a Bath indicator clamped to the side of the carriage bridge with the contact point of the indicator resting on one of the inside ways. The indicator is placed in contact with the flat way at the front and the saddle slid along the bed to test the parallelism ver-

FIG. 7. SCRAPING THE SADDLE

FIG. 8. TESTING WAYS WITH BATH INDICATOR

tically of the outer and inside ways. The indicator can then be set against the side of the inner V to test for parallelism sidewise.

In scraping the saddle and bed the surfaces are worked down under the skilful manipulation of the scraper until good, broad contact is assured throughout the entire length of the bearing surface. After the saddle and bed are scraped together the guide on the cross-bridge for the cross-slide is attended to. In scraping this dovetail guide the side of the guide is used, as shown, as a gaging surface for bringing the bridge square with the carriage V's. Fig. 9 shows the method of testing which involves the employment of a fixture planed and scraped on the bottom to rest squarely on the tailstock ways, and having at either side a finished surface which is perfectly square with the guide surfaces planed in the bottom. A size block with a bevel edge conforming to the slope of the dovetailed edge of the carriage bridge and having a flat back adapted to rest against the finished surface on the side of the test fixture, is placed between the fixture and the cross-slid guide and then slid along the guide in the manner indicated. If the surface thus tested is not at exact right angles with the ways the test block reveals the fact immediately and scraping is continued until the desired result is obtained.

The cross-slide and its gib are scraped to a nice fit on the dovetail guide on the saddle, and the gib seats and the bearing surfaces of the various members of the taper attachment are also properly fitted by scraping. The top of the apron and the corresponding surfaces under the front of the saddle are also scraped to a true joint so that when the apron is fastened in place there can be no possibility of its springing the carriage. And so on with each part of the lathe; any surface whose condition can in any way affect the accuracy of the assembled machine is scraped to assure a true bearing.

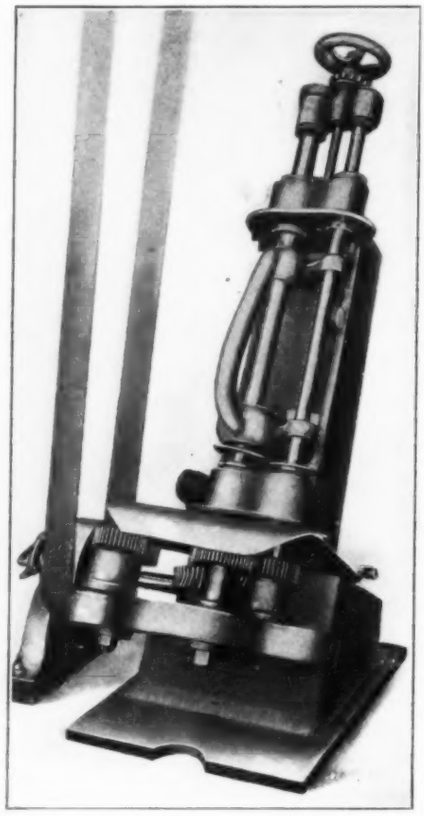


FIG. 11. BORING MACHINE FOR HEADSTOCKS

### Operations on Headstocks and Footstocks

In Fig. 10 is shown the fixture to which the headstock and the tailstock base are scraped, this having one V and one flat way corresponding exactly to the inside ways on the lathe bed. The head is rested upside down on a special stand while being scraped. After the bearing surfaces are scraped to the fixture the headstock and tailstock are bored out on special machines, shown in Figs. 11 and 12. Here the headstock and tailstock are placed on ways corresponding to those on the lathe bed and bored with cutters in boring bars carried in master heads. Referring to Fig. 11, which shows a headstock being machined, it will be seen that the four holes for the spindle boxes and back-gear shaft bearings are bored simultaneously. The two cutter bars are supported in heads resting on the ways of the machine, the bearings in these heads being at the exact hight and distance apart required for this size of lathe head. A separate pair of these heads is, of course, necessary for each size of lathe head. The boring bars carry double-end cutters and slide through cast-iron sleeves to which they are connected by feather and spline, the sleeves themselves rotating in lumen-bronze bearings fitted in the supporting heads.

The bars and their bearing sleeves are rotated by the spur gearing, shown at the lower end, this gearing being driven by worm wheel and worm actuated from the belt pulley at the left-hand side of the train. The gear bracket is adjustable for center distance so that the gear drive can be used for different sizes of heads bored on the machine. The larger of the two boring bars operates a star feed at the top of the machine, and the feed screw thus actuated runs the bars and cutters downward through the work. The yoke supporting the upper ends of the two boring bars is counterbalanced by weight and

FIG. 9. TESTING CROSS-SLIDE GUIDE

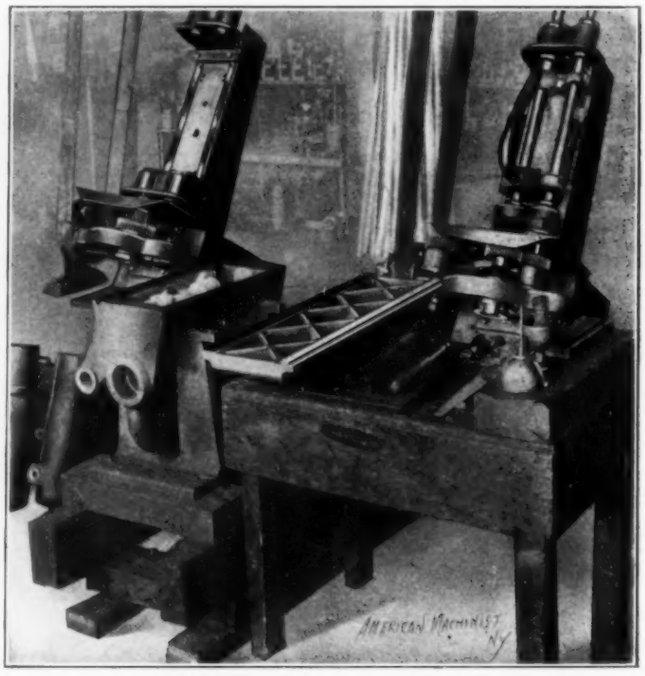


FIG. 10. SCRAPING FIXTURE FOR HEADSTOCKS

chain not shown, and is moved up or down in adjusting the cutters to the work, or in removing them, by means of the hand wheel on the feed screw.

The work and the bars in this machine have an inclination of about 45 degrees so that the chips do not fall down and grind into the lower bearings, neither do they lodge in the bearing being bored and interfere with the free action of the cutters. This type of machine has been in service at the Hendey shops for a number of years and has given entirely satisfactory results.

When boring headstocks the work is placed on paper about 0.0025 or 0.003 inch thick in order that the headstock center may be bored that much lower than the tailstock, thus leaving sufficient extra material at the bottom of the latter to allow it to be scraped down to correct hight when fitting up the lathe. Before the tailstock itself is placed on the boring machine not only are the V and flat ways underneath its base scraped to the fixture, shown in Fig. 10, but the flat top of its base and the under side of the upper or main part are also scraped true so that the tailstock can be assembled and bored out in the condition in which it will be fitted to the lathe.

FIG. 12. BORING MACHINE FOR TAILSTOCKS

### Inspecting the Lathe Head and Spindle

The lathe as leveled up under the testing countershaft for inspection is shown in Fig. 13. The taper hole in the head spindle and the taper center hole in the bushing which fits in the mouth of the spindle are tested for running truth by an indicator applied at the mouth of the hole. Similarly the spindle is tested for end motion when running, by application of the indicator to the face of the collar on the spindle nose. The alinement of the head spindle with the shears of the lathe and the alinement of the taper hole with the spindle are tested with the bar shown in position in the spindle in Fig. 14. This bar projects from the spindle 12 inches and carries three machine-steel collars, placed one at each end and one in the middle, which are used as turning points from which all measurements are taken. A light cut is taken across these collars with a keen diamond-point turning tool, and the collars are then measured with a micrometer, as illustrated in Fig. 14. Uniformity in diameter of the three collars shows that the horizontal alinement of the spindle is correct. The test is really a measure of the accuracy of the lathe for boring and for that reason it is desirable that the outer collar should be found a trifle larger than the one next the spindle nose, thus insuring that a hole being bored in the lathe shall not taper in the wrong direction, that is, become larger toward the rear end than at the front. So in scraping the under side of the head, when this is found necessary in testing the spindle alinement, the front end of the head is purposely drawn very slightly toward the rear of the bed so that the outer test collar will turn, say up to 0.0005 inch larger than the collar next the spindle. The alinement of the spindle in the vertical plane may be tested by attaching the indicator to the tool post and traversing the carriage along its ways with the contact point of the indicator pressing against the top or bottom surface of the collars.

In testing the alinement of the taper hole with the spindle itself, the test bar after the collars have been turned off, is removed, turned half way round and replaced in the spindle; the indicator is then put in the tool post in place of the turning tool and with contact point on the center line the indicator is traversed past the collars, the movement of the pointer over its graduations showing double any error

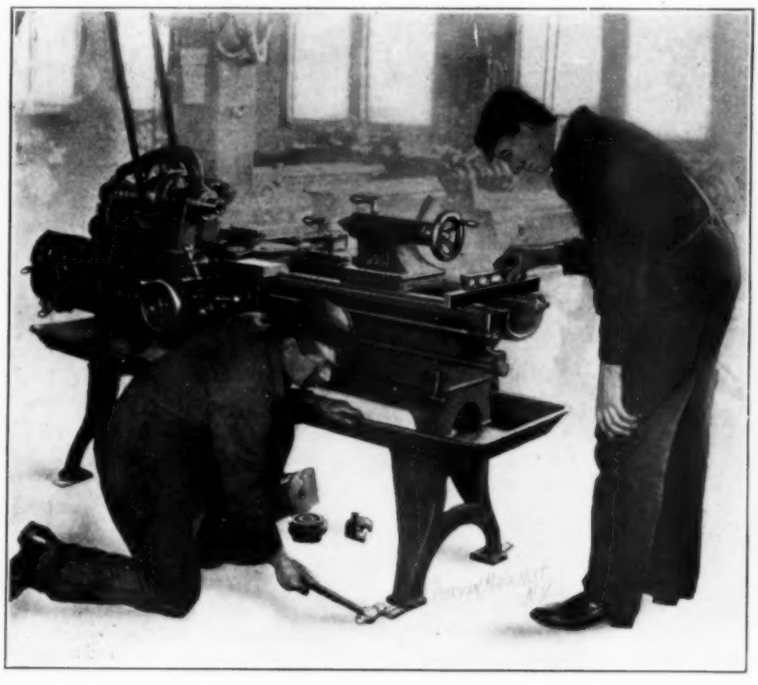


FIG. 13. LEVELING THE LATHE FOR INSPECTION

FIG. 14. TEST BAR USED IN TESTING SPINDLE ALINEMENT

there may be in the alinement of the taper. Another test in connection with the spindle is performed to discover if the requisite allowance for a film of oil has been made in fitting the spindle to its boxes. The taper journals of the spindle run in lumen-bronze bearings which are cylindrical on the outside and fitted in straight seats bored through the headstock uprights. A loose thrust washer is placed between the inner face of the collar on the spindle nose and the outer end of the front bearing. In scraping in the spindle the front journal when dry is permitted a freedom of 0.0005 to 0.00075 inch in its bearing to allow for lubrication, this having been found by experiment to be about the right amount to leave for the film of oil which surrounds the spindle when in operation. In order to determine if this allowance has been provided a lever is placed under the spindle nose and the spindle lifted, the amount of freedom being shown by an indicator placed in contact with the mouth of the hole in the spindle.

### Tailstock Tests

Fig. 15 shows the method of testing the alinement of headstock and tailstock. A pair of dummy centers with ends ground flat and to the same diameter are placed in the live spindle and tail spindle, the latter is run way back into the tailstock and clamped and the tailstock slid forward until the two centers are brought together. The Bath indicator is applied to the front side of the plug centers on the center line to facilitate adjustment of the tailstock sidewise into alinement with the head center, then, as illustrated, the indicator is used on the under side of the two centers to test the alinement vertically. The tailstock is then slid back and the spindle run way out until in its extreme forward position it brings the flat-end center again in contact with the similar center in the head spindle. After clamping the tailstock as before, the indicator is again applied beneath the two centers and also at the front side, these tests revealing any inclination of the tail spindle upward or downward, toward the front or the rear.

As previously stated, the tailstock is bored a trifle high relative to the head, thus leaving a little surplus metal at the bottom for scraping down in these final fitting and alining operations. In connection with the scraping and testing processes described as relating to the tailstock it should be noted that during the inspection the alinement of the tail spindle with the head spindle is tested at three different positions on the bed; that is, it is slid back to the middle of the bed and then to the outer end, and in each of these positions the indicator is applied to the plug centers in head and tail spindles in the same manner as when the tailstock is close to the head.

**Lathe Spindle tests made with bar 12" long fitting firmly in taper of lathe spindles; bar having three equidistant collars or turning points of machine steel from which all measurements are taken.**

| | | | |
|---|---|---|---|
| Turns in 12" with sharp tool and light chip on test bar in spindle. Measurements at outer end compared with head end | Large | Exact | Small |
| | 1/2 | | |
| | Up | Straight | Down |
| Alignment in 12" | | X | |
| Spindle found to turn round, with no deflection shown on indicator | | | |
| | Head | Center | End |
| Variation in alignment of taper hole in spindle shown by bar turned half way around in hole | X | 1/8 | 1/4 |
| | Convex | Straight | Concave |
| Spindle and face plate align with cross slide, tested by actual turning and facing of large face plate When finished the plate is | | X | |
| | Out | | True |
| Taper hole in spindle runs | | | X |
| " " " bushing " | | | X |
| End motion in spindle " | | | X |
| Tail spindle points when out full length | In | | |
| | Straight Horizontally | | X |
| | Out | | |
| | Up | | |
| | Straight Vertically | | X |
| | Down | | |
| | | 1 | 2 3 |
| Tail spindle aligns with head spindle in three positions on bed | Up | | |
| | Exact | X | X X |
| | Down | | |

Taper attachment bar aligns with ways of bed when at 0 _____

Date of inspection _____

Inspected by _____ Shop Inspector

Endorsed by _____ Chief Inspector

*American Machinist, N.Y.*

FIG. 17. PART OF HENDEY LATHE TEST SHEET. RESULTS GIVEN IN THOUSANDTHS OF AN INCH

### Cross-slide Test

The cross slide is tested to determine if it is square with the spindle by taking a cut over the face plate, as shown in Fig. 16. After the plate has been faced across it is tested by straight-edge and tissue paper placed under the ends and near the center. It is preferable in this test that the cross-slide tool shall be found to face the plate very slightly concave; to pass inspection the plate may be either perfectly flat, or up to 0.001 inch hollow. The line engraving in Fig. 17 represents a portion of a Hendey test sheet which is self-explanatory.

FIG. 15. TESTING ALINEMENT OF HEADSTOCK AND TAILSTOCK

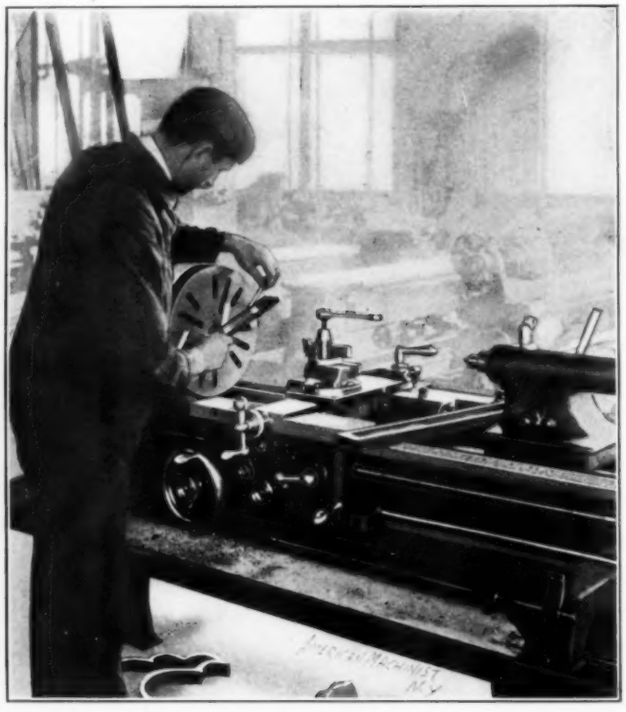


FIG. 16. CROSS SLIDE AND FACE PLATE TEST

# Still Another Artsmith

By E. A. Dixie

There is an old English adage that "there are more ways to kill a dog than by choking him to death with butter." There are also more ways of making wrought-iron flowers than by forging the separate pieces and welding them together. Most of the flowers shown in the accompanying halftones are not built up of separate pieces, as were those shown in previous articles describing the work of Louis Van Boeckel, of Belgium, and James Cran, of Plainfield, N. J. They are forged from the solid. The man who does this work is Ernest Schwartzkopf, foreman smith for the firm of McDougall & Porter, engineers, who have two shops in New York, the one at Fifty-fifth street, and the other at One Hundred and Forty-first street and Rider avenue, the Bronx. Mr. Schwartzkopf has been an ornamental and general iron worker for many years, and his work not only shows the inborn artistic touch, but the clean-cut work of the skilled mechanic.

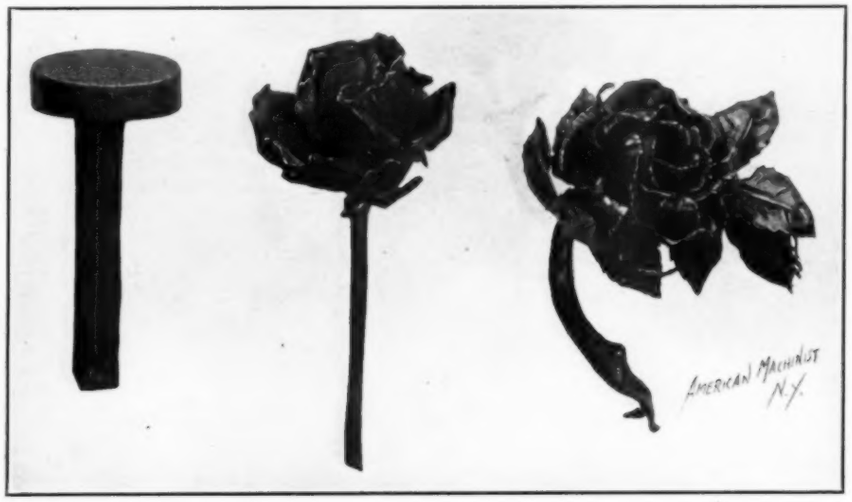



FIG. 1. BLANK AND FINISHED ROSE

FIG. 4. AN UMBRELLA STAND

His methods are entirely different from those of either Van Boeckel or James Cran, whose work I described and illustrated on page 10, Part 1, both of whom forge the parts, assemble them and finally weld them together. Ernest Schwartzkopf forges his roses, tulips, sunflowers, passion flowers, etc., from the solid. Fig. 1 shows, to the left, the blank for a rose. The shank is about ⅝ inch square by 4¼ inches long. The head is approximately round, 2⅛ inches diameter by 9/16 inch thick. With slight modifications of sizes, the blanks for roses, sunflowers, daisies, passion flowers, etc., are practically the same. As in my former article on page 10, Vol. 32, Part 1, I described Mr. Cran's method of producing a spray of roses, I will confine myself in this article to a description of Mr. Schwartzkopf's method

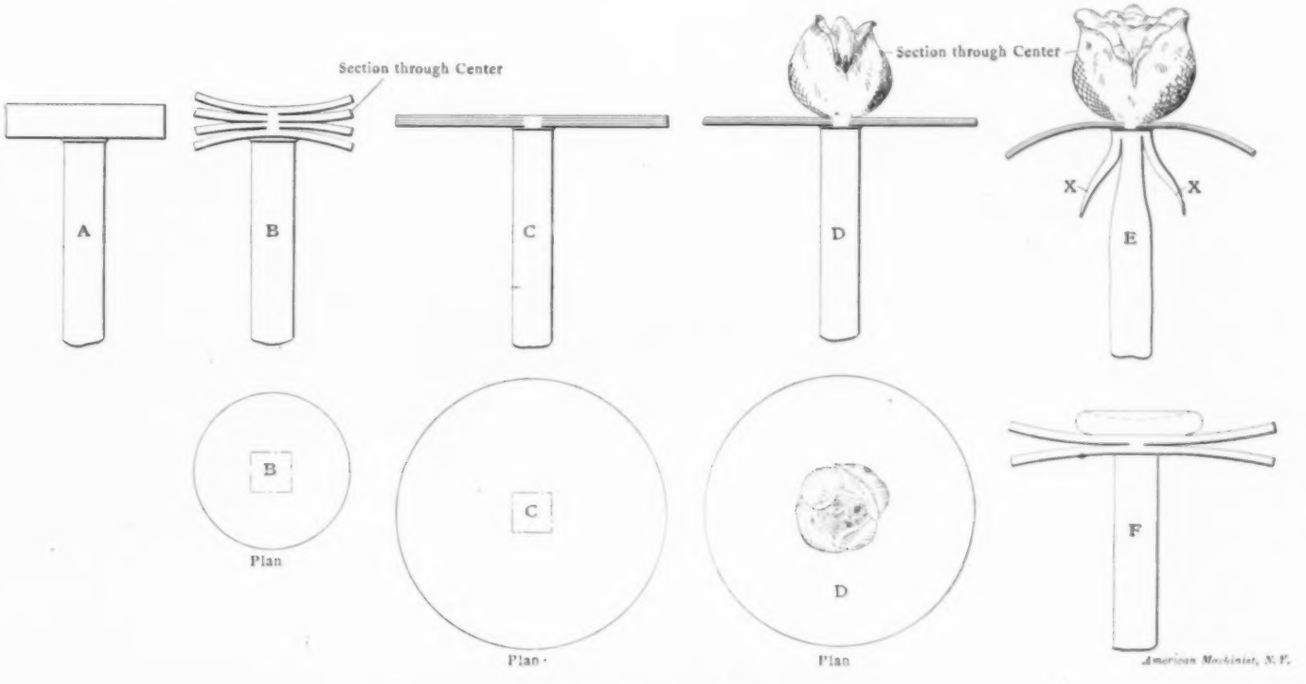



FIG. 2. EVOLUTION OF A ROSE

FIG. 3. SELECTION OF VARIOUS FLOWERS MADE IN THE SAME MANNER

of producing the same thing, but show halftones of other flowers. I may mention that he also makes bronze flowers, but the petals of these are brazed together.

Fig. 2 shows how the forging is done. The head of the blank *A* is split into disks, as shown at *B*; it is then heated to a good forging but not welding heat, and the disks are forged out thin, as shown at *C*. The center leaf or disk is then cut into the shape of four or five petals and bent up into shape, as shown at *D*. The next disk is treated in the same way and so on until the rose is finished. The calyxes *X* are cut with a hot chisel from the square corners of the stem, which is then forged to proper thickness. At *F* in Fig. 2 is shown a typical section for a sunflower.

Fig. 3 shows a selection of various flowers, all made in practically the same way. At the lower left side of Fig. 3 are two pieces of cold-hammered work; the larger one is of copper and the smaller one of sheet steel. The latter is made in two parts brazed together at the round end.

Fig. 4 shows an umbrella stand which is considerably out of the ordinary. The halftone fails entirely to show the beauty of this piece of work.

Fig. 5 shows a wreath of flowers; you can pick them out and classify them for yourselves.

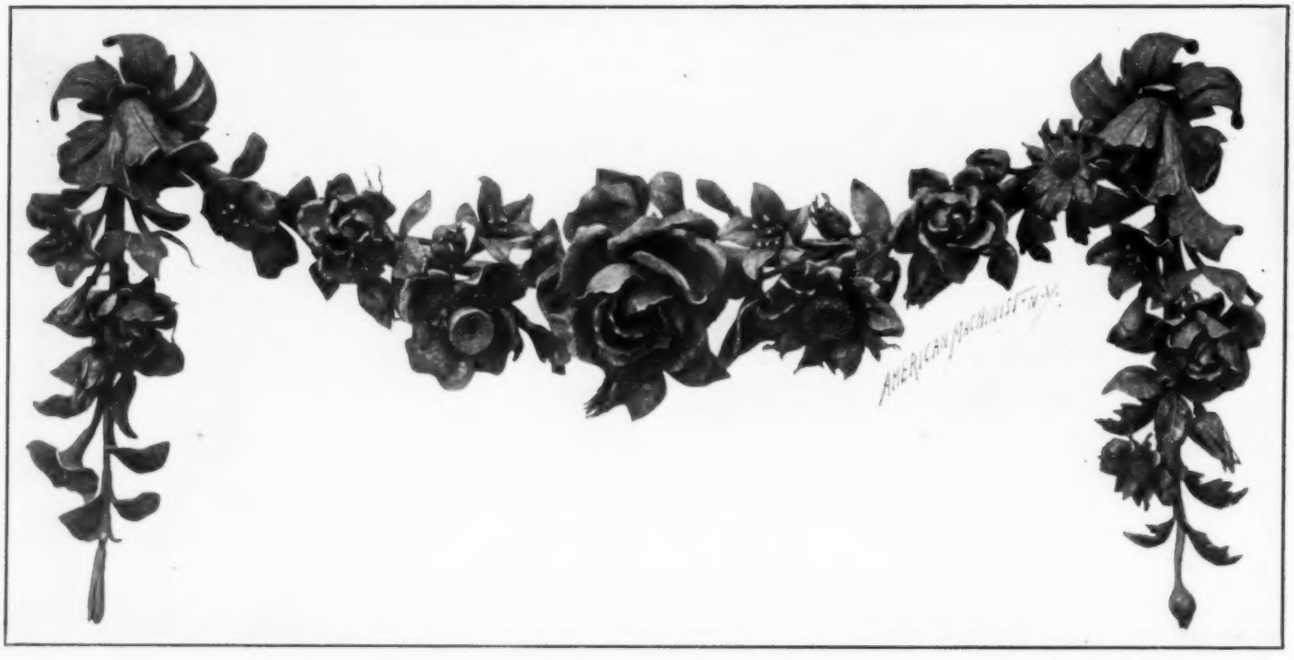


FIG. 5. A WREATH OF ARTISTIC WORK

# Welding Metals with Electricity

## Automatic, Semi-automatic and Hand-Operated Machines for Butt, Lap and Spot Welding. Time and Current Consumed, Kind of Metal Welded

BY E. F. LAKE

Many different kinds of machines have been developed within the last few years to use electricity in making welds on the different metals. Their practical use commercially has now been thoroughly demonstrated, and under certain conditions this is one of the best methods to employ in welding metals.

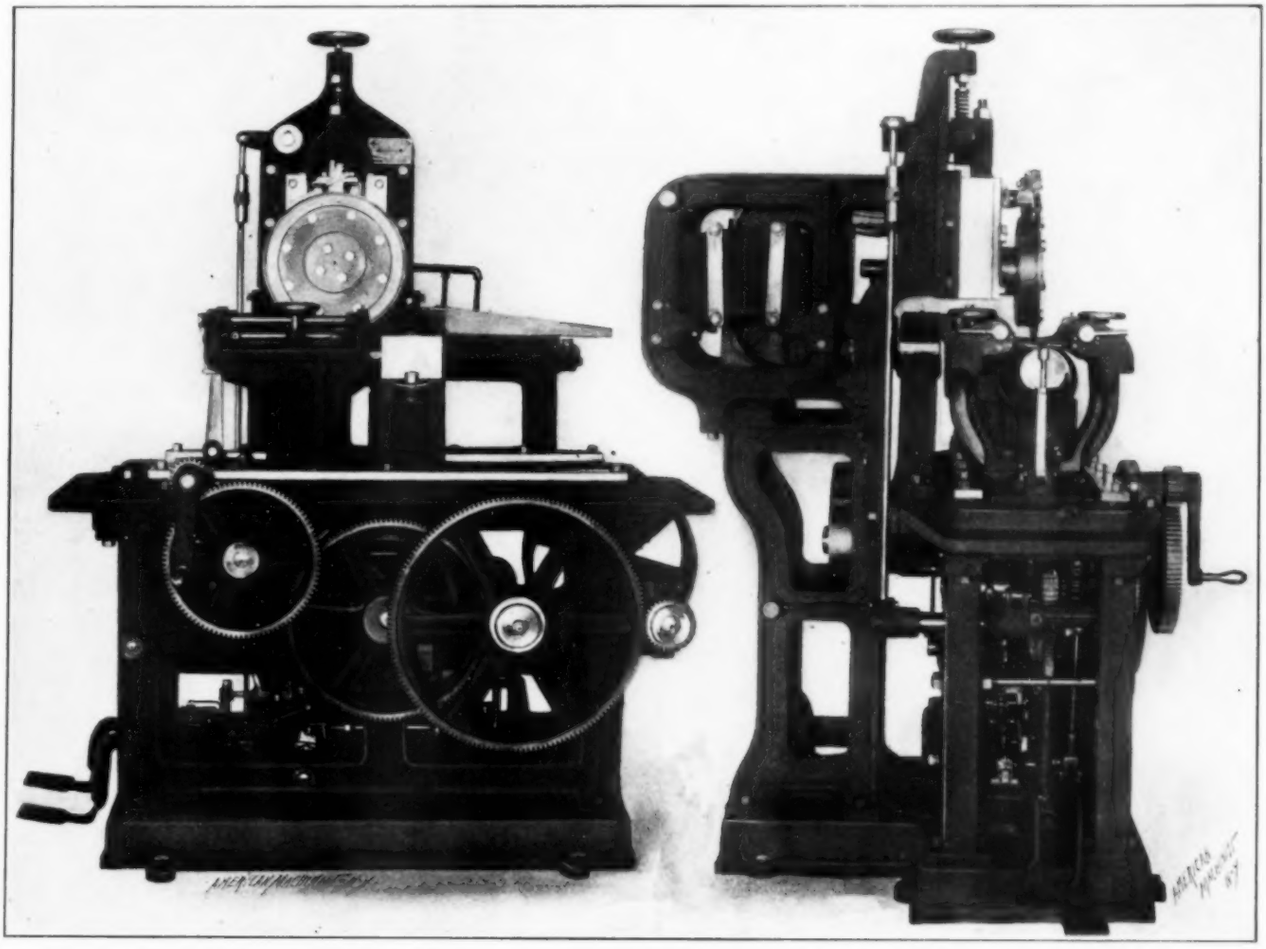


FIG. 1. FRONT AND SIDE VIEW OF MACHINE TO AUTOMATICALLY ELECTRIC WELD THE SIDE SEAM IN COFFEE POTS

There are two electrical processes used in the welding of metals, namely, arc and resistance. This article deals entirely with the resistance process and arc welding will be left for some future article.

While iron and steel have been welded for centuries it is only very recently that it has been done in any way except with the forge fire, unless it be in the laboratory, and iron or steel were the only metals easily and successfully welded in this way. With some of the new processes of welding, however, many of the nonferrous metals are welded as easily as iron or steel, and in the electrical process described here copper and brass are readily welded.

With the old forge fire it was necessary to bevel off the ends of the pieces to be welded together, which is commonly called scarfing; but with this electrical process, the pieces are butted together, and the weld that is thus made is much stronger than any welds made in the forge fire, unless it be under exceptional conditions. The weld is also much more quickly made, as quite a number of welds can be made with these electrical machines in the same time that it takes to make one with the forge fire.

### Automatic Welding

With the use of electricity in this way the machines can be made so they will do the work entirely automatically, or they can be made semi-automatic, power operated, or hand operated as the conditions may require. Machines have been made and used that weld metals with a section of 4 square inches. Machines that would handle larger sections could be built if any work required it. Pieces to be welded do not necessarily have to be square, as oblong, octagonal, hexagonal, or any irregular shape can be welded providing the area on the welded section is not larger than the machine is designed to take care of.

The front and side view of an automatic electric welder that was built by the Thomson Electric Welding Company, Lynn, Mass., is shown in Fig. 1.

This machine was built for welding the side seam on coffee pots. The sheet metal that forms the sides of the coffee pot is first formed into cylinders, and these are passed through the hole in the copper casting under the revolving disk. The disk

forms one electrode, while the casting forms the other. This disk revolves with a bearing on the seam of the coffee-pot cylinder, and thus makes the electrical connections that generate the heat in the metal at the welding point. The cylinder is made to automatically travel through the machine as fast as the seam is welded, by the carriage, which holds the copper casting in which it is placed, moving along the ways. The mechanism of the machine is plainly shown in the two views.

The principle on which this process of welding is based is that the joint between the two pieces of metal to be welded together will resist the current passing through them and cause heat to generate at this place by forcing through the metal such volumes of current that its own resistance is sufficient to bring every molecule of the section affected by the current to the temperature that will allow them to be squeezed together and thus form a weld. This forces out the outside overheated or burned metal and brings the molecules together in nearly as homogeneous a mass as that of the original bar.

### Electric Compared with Forge-fire Welding

It is not necessary to bring the metals to a molten state as is the case with many other welding processes, but only a good welding heat is needed. In fact, if the metal becomes molten it merely runs out of the joint and a good weld cannot be obtained unless the machine has motion enough to squeeze the molten metal out and bring that which is heated to the white welding heat together.

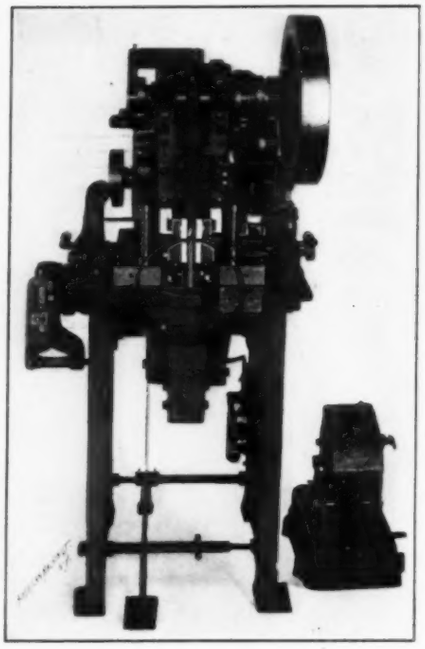


FIG. 2. AUTOMATIC ELECTRIC WELDER FOR FLAT BANDS

In comparing this with the welding in a forge fire, we see that in the forge the metal is inserted in the fire and surrounded with live coals. Thus it must absorb all of its heat from the outside, and when at the welding heat, the metal will be hotter on the outside than in the center or the core, which is just the place where the heat is most needed. With this electric process, however, the core is the best protected from radiation and hence will become heated first.

Another difference is that in the forge fire only a small part of the heat generated is communicated to the metal, while in this electric process the heat is generated in the metal itself and hence it is all usefully applied.

A third difference between electric and forge-fire welding is that the nonferrous metals can be welded as successfully as the iron products, whereas with the forge fire it is possible to weld only iron and steel successfully.

### How to Make Electric Welds

There are three kinds of welding done with these electrical machines, namely, butt welding, lap welding and spot welding. The machine shown in Fig. 1 is for lap welding, and this kind of welding has been successfully done commercially on metals as thick as ¼ inch.

In this lap-welding machine the two sheets are overlapped about ⅛ inch and the revolving disk electrode passes over it to heat the metal to the welding heat. At the same time the two sheets are squeezed together and no shoulder or other imperfections are left. This makes the welded joint practically the same thickness as the original sheet, and only the experienced eye can see where the weld has been made.

In welding metals with a rusty surface, the worst of the rust should be cleaned off. The blue scale which forms on iron should also be removed from both surfaces of the intended joint and also from the places where the metal is clamped. Otherwise no special cleaning of metals is necessary when electrically welding them

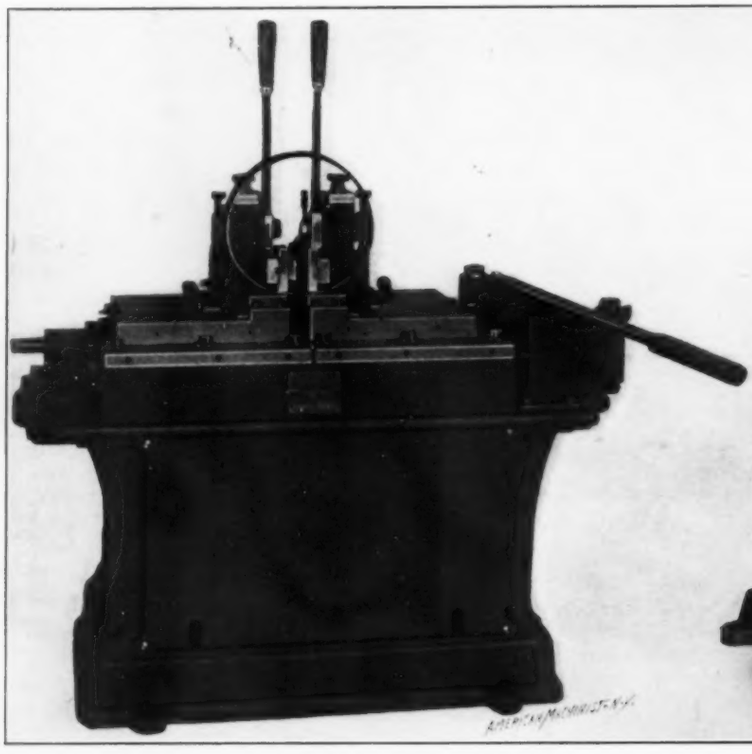


FIG. 3. MACHINE FOR ELECTRICALLY WELDING FLAT BANDS

FIG. 4. MACHINE FOR WELDING METAL UP TO ¾X2 INCHES

as any grease or dirt, which may be on the steel, either burns off or is squeezed out when the two ends are brought together. All slag, etc., which may form when the metal is heated, is squeezed out and only the pure metal united.

In making welds the heat is localized in a very small area and the weld made almost instantaneously as the current is almost entirely concentrated in the joint owing to the imperfect electrical connection, and the hotter the metal becomes the greater is its electrical resistance.

As the metal heats quickly, so also does it cool rapidly owing to the heat being confined in such a small area that the mass of the metal, which remains cold, conducts away the heat.

In steels fairly high in carbon, this may be considered a disadvantage, as it might be necessary to anneal the metal, after welding, before it could be machined. In any case, however, it would be better to anneal it after welding, as this would relieve all strain that might have been set up; and would tend to reduce the structure from the coarse grain, that might be caused by overheating, to the fine grain of its normal texture.

### Butt Welding

A Thomson automatic machine for butt welding flat bands is shown in Fig. 2. In this machine the opening and closing of the jaws to hold the work; the movement of the clamps together, that are formed by these jaws, when the metal is hot enough to make the weld; and the opening and closing of the circuit are all automatic. The time in heating is from three to five seconds and all the operator has to do is to put the band in and take it out; the operator in this case being a boy.

In this butt-welding process, each pair of clamps forms one terminal of the secondary winding of the transformer. The clamps are so adjusted that they will be moved toward each other by the pressure given by springs or weights. The only thing that keeps them from touching each other is the pressure between the ends of the pieces to be welded. As soon as the metal softens, this pressure exerts itself, and when the clamps have moved far enough to squeeze the softened surfaces together, they trip a switch in the primary circuit, thus shutting off the current and the job is done.

The weld is made so quickly that it is better to have an automatic trip than to depend on the operator for tripping it. If the current is turned off too quickly the weld will break easily, and if not turned off quickly enough, a very large fin forms around the weld, thus causing extra work. Arrangements could be made to reduce this fin, in the machine, while still hot, but ordinarily it is more practical to remove it in the ordinary way. A trial weld can be made to show whether too little or too much squeeze has been given and the trip set from this trial weld.

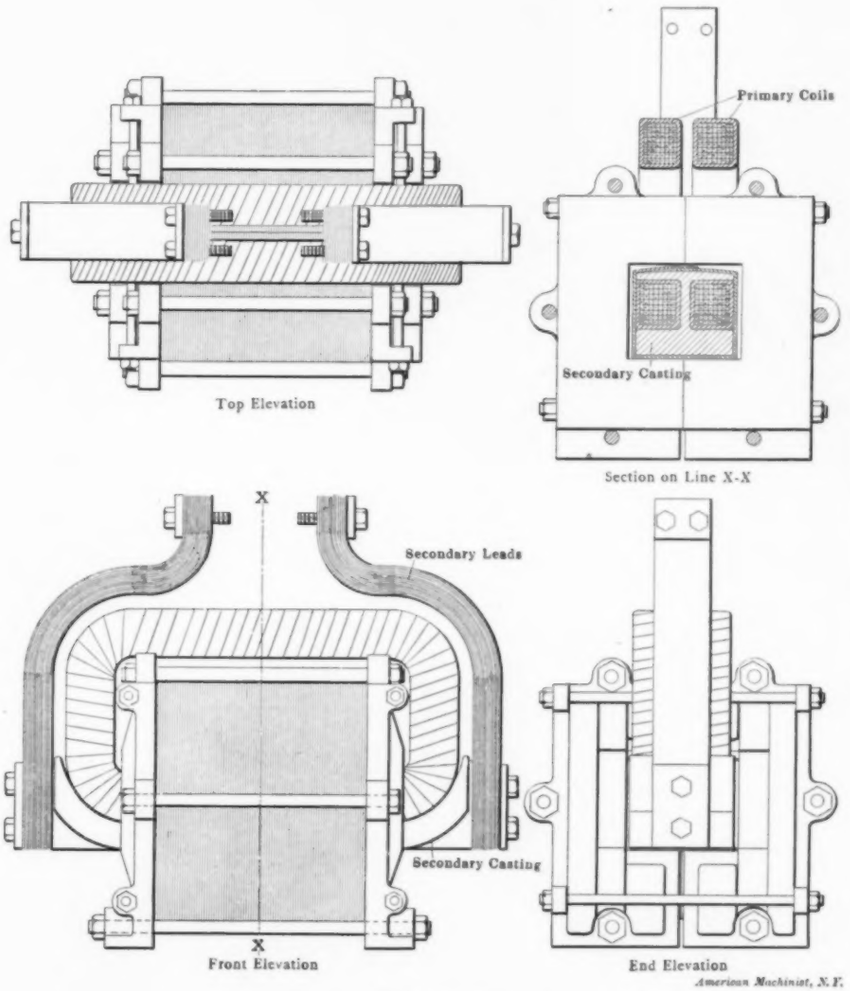



FIG. 5. ASSEMBLE OF TRANSFORMER

### Hand Operated Butt Welders

Two hand-operated butt welders are shown in Figs. 3 and 4. Fig. 3 shows the machine built by the Thomson Electric Welding Company, Lynn, Mass., and Fig. 4 shows the one built by the Toledo Electric Welding Company, Toledo, O. In the machine in Fig. 3 the lever to the right is used to squeeze the metal together to make the weld. The two upright levers on both machines operate the jaws that clamp the metal, and a blow with the hand releases them when the weld is made.

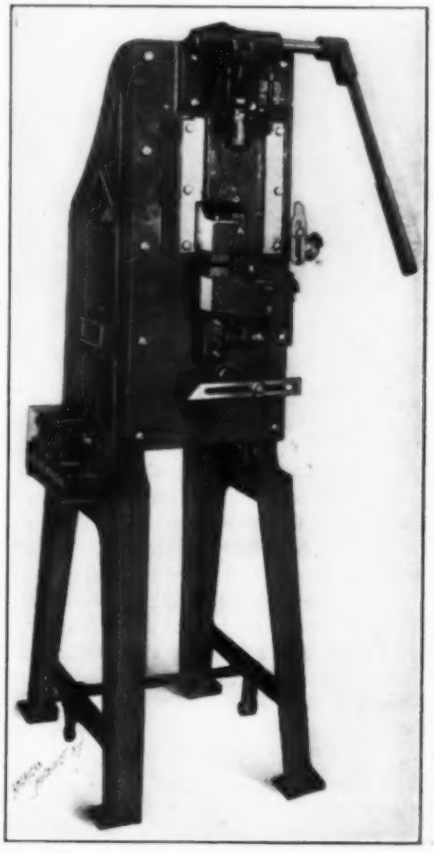


FIG. 6. THOMSON SPOT WELDER

In the Toledo welder shown in Fig. 4 the lever at the right is pressed until the ratchet dog catches. This holds the clamping jaws open until the metal to be welded is placed in position. Releasing the trigger on the lever then causes the ends of the metal to be pressed together by a spring mechanism in the sliding

FIG. 7. TOLEDO SPOT WELDER

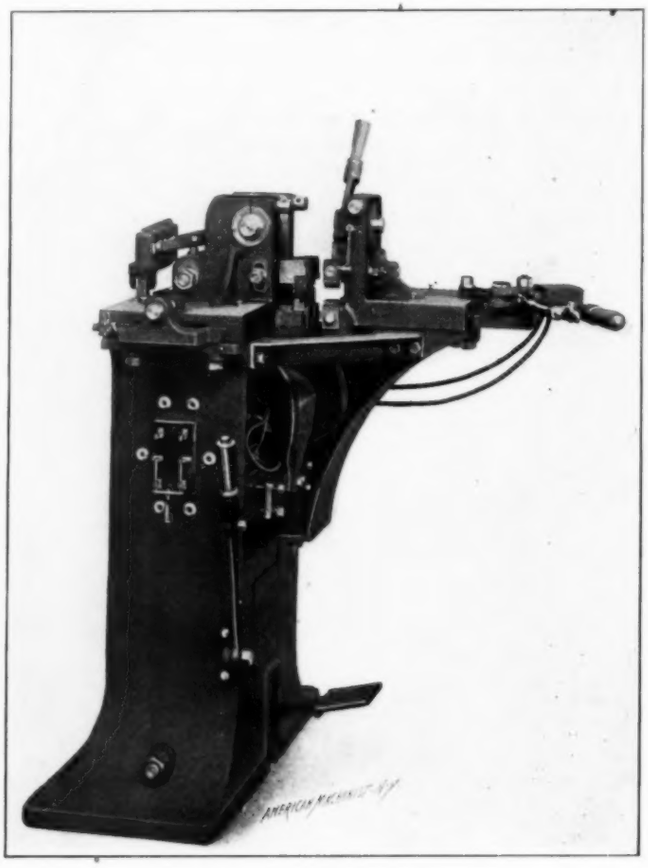


FIG. 8. MACHINE FOR MAKING T WELDS

head. Pressing down on the automatic switch lever, back of the clamp, closes the switch that turns on the current and causes the metal at the welds to heat, while the spring mechanism maintaining a uniform pressure forces the metal together as it softens. At any predetermined point the automatic switch can be made to open and cut off the current when the weld is finished.

### Cost of Butt Welds

The cost of making butt welds on round iron or steel from ¼ to 2 inches in diameter, with the cost of current at 5 cents per kilowatt hour, which is about the average price when buying it from lighting companies, and also the time consumed in making the welds, is shown in Table 1.

### Current Used

The current that is used for welding in any of these machines is a single-phase alternating current of any frequency and either phase of a two- or three-phase circuit can be used.

The voltage used in the machines is generally from 2 to 6 volts and to obtain this extremely low voltage, a special transformer is used that reduces the 220 or 440 volts, usually given out by the generator employed in factories.

This transformer is usually located inside the bed of the machine body. A line cut of the one used in the Toledo machine is shown in Fig. 5 and one of a similar design is used in the Thompson machine.

When current is purchased from a local

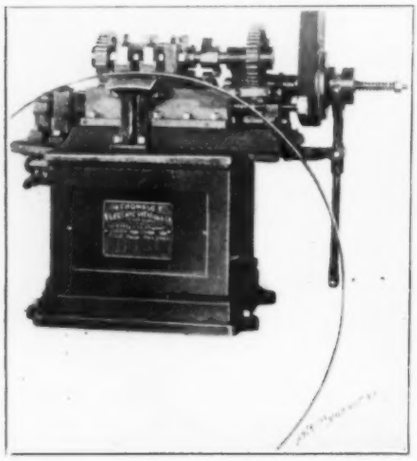


FIG. 9. ELECTRIC HOOP WELDING MACHINE

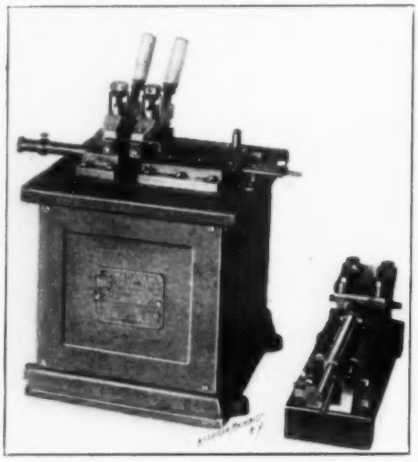


FIG. 10. COPPER WIRE WELDING MACHINE

FIG. 11. MACHINE FOR WELDING BUGGY DASH FRAMES

lighting company, it usually furnishes a 220-volt transformer and this current can be used and reduced by the welding machine transformers to the desired voltage.

The amperes that are used depend entirely on the kind of work to be done and the size of the transformer. The low voltage used in the welders makes it perfectly safe, as a person cannot feel the slightest shock.

### Advantages of Electric Welding

In these machines the metal is visible at all times, and can be watched while heating, as the heat is entirely between the clamping or vise jaws that hold the pieces. The temperature can be maintained at any point desired and for any length of time. Any degree of heat can be obtained up to the melting point, and this can be increased or decreased at the will of the operator. No fluxes are necessary. The hotter the metal becomes, the greater is its resistance to the flow of electric current, and consequently as the edges of the two ends heat, the current is forced into the adjacent cooler parts until there is a uniform heat throughout the entire mass to be welded; all of which is accomplished in an entirely automatic manner.

| Round Iron Diam. Inches. | Area in Sq.In. | Kilowatts Trans. | Seconds to Make Weld. | Cost per 1000 Welds; Current 5c. per Kw.-hour. |
|---|---|---|---|---|
| ¼ | 0.05 | 5 | 5 | $ 0.35 |
| ⅜ | 0.11 | 7½ | 6 | 0.65 |
| ½ | 0.20 | 8 | 10 | 1.10 |
| ⅝ | 0.31 | 10 | 12 | 1.65 |
| ¾ | 0.44 | 12 | 15 | 2.50 |
| ⅞ | 0.60 | 15 | 20 | 4.15 |
| 1 | 0.79 | 18 | 30 | 7.50 |
| 1¼ | 0.99 | 20 | 30 | 8.30 |
| 1¼ | 1.23 | 26 | 40 | 14.45 |
| 1½ | 1.77 | 40 | 60 | 33.35 |
| 1¾ | 2.41 | 45 | 70 | 43.75 |
| 2 | 3.14 | 56 | 80 | 62.20 |

TABLE 1. TIME AND COST OF ELECTRIC BUTT WELDS.

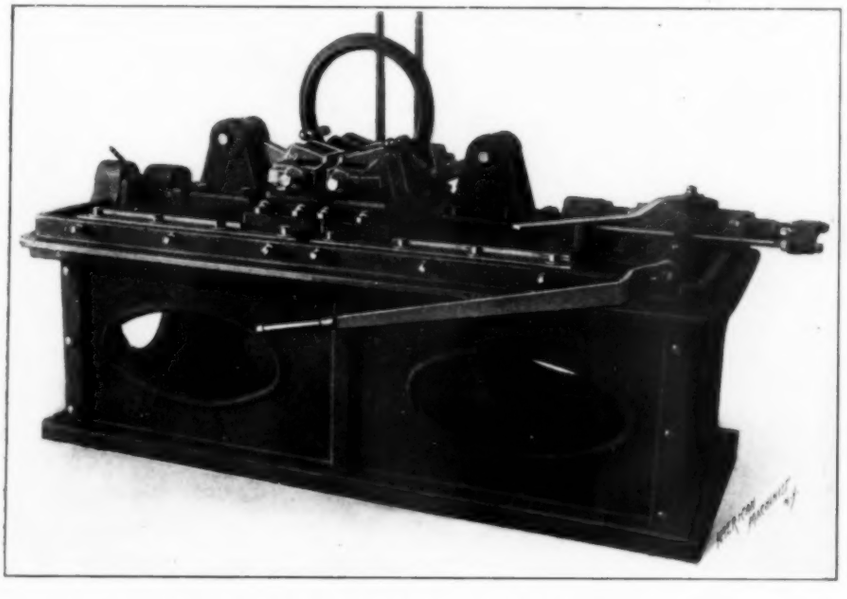


FIG. 12. MACHINE FOR WELDING STEEL UP TO 1½ SQUARE INCHES

### Spot Welding

Spot welding is another kind that is done with electric machines. No automatic tripping is necessary with this form of welding, owing to the small travel of the electrodes, and the small liability of burning the metal. Besides that, it is not easy to effect on these machines, and therefore the duration of the current is determined by the operator.

In Fig. 6 is shown the Thomson spot welder. In operating this projections are punched on the attachments to be welded on, and through these the current passes to make welds in spots or points. When the two pieces to be welded are placed between the jaws the long handle is moved in and brings the electrodes together to make the welds. This is the work of but an instant and many welds can be made in a short time.

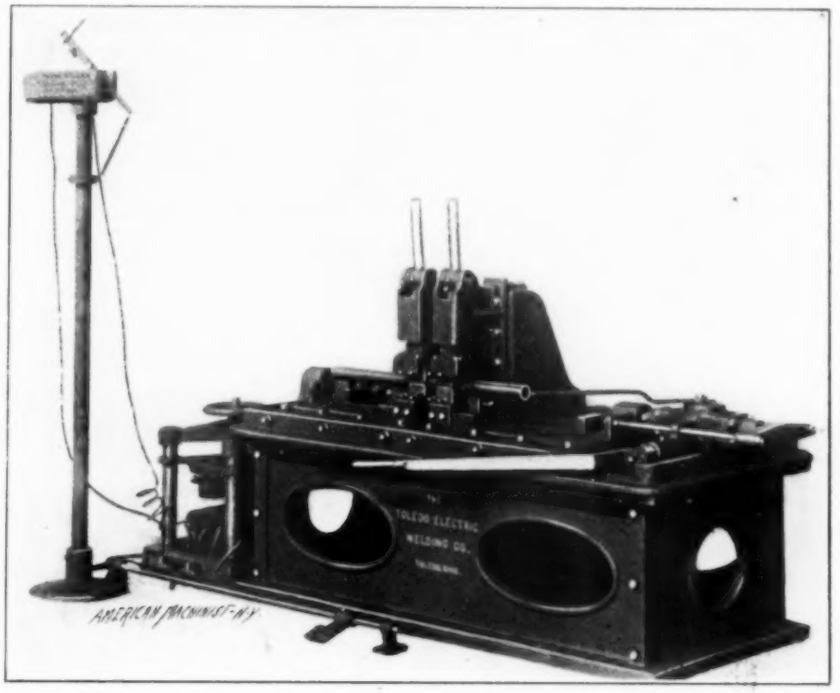



FIG. 13. ELECTRIC PIPE WELDING MACHINE

In Fig. 7 is shown the Toledo spot welding machine. In this the lever handle at the top of the machine is pushed forward, thus forcing the upper side down until it touches the metal. The slight pressure on the foot switch, shown on the floor, makes the weld.

### Use of Spot Welds

Spot welding is very useful where a joint between two or more sheets of metal is made by drilling or punching holes and then riveting through them. The pieces are merely placed in position and met by the jaws of the welder when they come together, at the point where the rivet would be required.

Two or more thicknesses of metal can be fused together in that way, and it is more difficult to force them apart than when rivets are used. In fact, if the welding is well done, the metal will break away around the welds and the weld will remain intact. In one case four spot welds withstood a pulling strain of 7800 pounds before breaking.

### Making T Welds

A Toledo machine that was designed especially for making T-welds is shown in

Fig. 8. This machine has a bracket in front to hold the third head with its clamping jaws. The jaws open 1¼ inches high and 2 inches wide. The head and bracket can be removed by taking out eight bolts, leaving it practically the same as their No. 3 butt welders. The main piece is put in the two back clamps and the piece that forms the T is placed in the

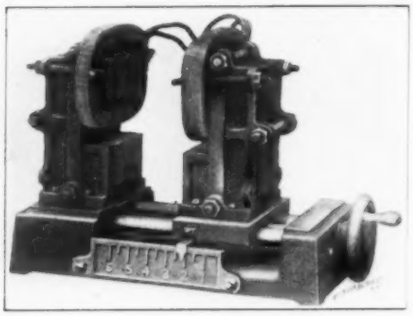


FIG. 14. REGULATOR FOR ELECTRIC WELDERS

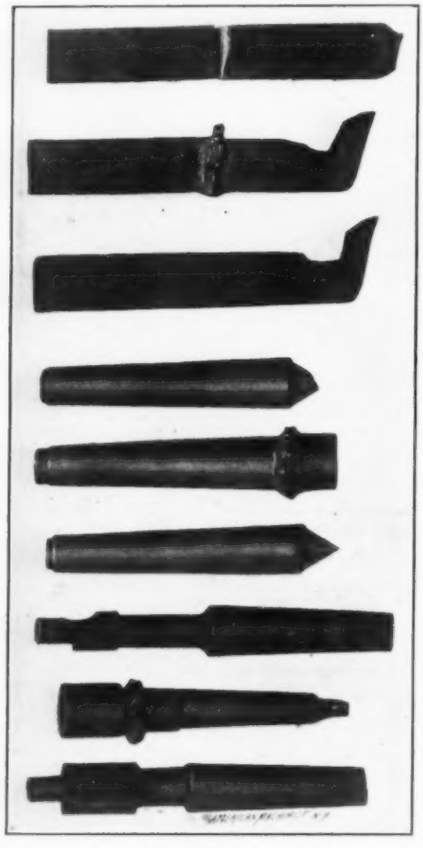


FIG. 15. ELECTRICALLY WELDED TOOLS

front clamp. The current is then turned on, and the lever in the front of the machine is pulled in to squeeze the metal together and form the weld. The switch is closed by pressing on the thumb latch on this lever. It will weld metals with a cross-section up to ¾ square inch.

### Electric Welding of Wire

A Thomson machine for electrically welding wire hoops is shown in Fig. 9. This is an automatic machine that is operated by a boy, and it welds the hoops as fast as the boy can put them into it; 950 hoops have been welded in an hour. This machine occupies a floor space 15x15 inches and is 20 inches high. It uses a current of 3 kilowatts and the time consumed in making a weld is from 3 to 4 seconds.

In Fig. 10 is shown a Thomson copper-wire welding machine, with automatic back switch, that welds wire in sizes from No. 16 to No. 6. After placing two pieces of copper wire in the clamps the weld is made automatically by touching the lever of the switch. It is also a 3-kilowatt machine and the time used in heating is from ½ to 2 seconds. A machine that will weld copper wire in sizes from No. 6 to ¼ inch is also made by this same company. This machine differs from the other by having a weight to pull its jaws together instead of a spring. In operation, however, it is semi-automatic, the same as the other one. It uses a current of 7½ kilowatts, and heats the wire in from 2 to 6 seconds.

The time and current used in welding copper with an area of from ⅛ to 1 square inch are given in Table 2. An idea of the cost can be obtained from these figures.

The machine shown in Fig. 11 is a Toledo machine that was designed for welding carriage and buggy frames. This machine makes welds similar to those shown on the piece of wire fence in Fig. 21 and has a record of 4800 welds per day of 10 hours, all of which were good welds.

### Machines for Large Work

In Fig. 12 is shown one of the large sized Toledo welding machines. It is shown with a heavy steel ring in the clamps ready to be welded. This machine requires two men to operate it. The helper stands back of the machine and clamps the work in the jaws and takes it out, while the welder stands in front to pump the long lever that operates a 5-ton hydraulic jack to force the ends together. For large stock it requires so much power to squeeze the two pieces of metal together to form the weld that a mechanical motion cannot be practically applied. It requires about 60 seconds to make a weld on steel that has an area of 1½ square inches. This machine occupies a floor space of 38x48 inches and is 40 inches high.

With the large machines it is possible to weld small stock, but it is not economical. Thus, a machine designed for welding 3-inch stock can be used on ⅛-inch rod, but the large machine operates slowly and consumes more energy than the small one. Likewise, larger stock can be welded on the small machines than they are designed for, but in doing this there is danger of burning out the coils in the transformer by overloading it.

### Pipe Welding Machines

A Toledo machine that is designed for welding pipe is shown in Fig. 13. In this the jaws open 2 inches high and 2 inches wide, so that it will take in the ordinary 1½-inch pipe.

The joint to be welded is squeezed together by an hydraulic ram that is worked by pumping the long lever in front of the machine. The special switch for opening and closing the primary circuit in the

| Area in Sq.In. | Time in Seconds. | Kilowatts Transmitted. |
|---|---|---|
| 0.125 | 8 | 7.5 |
| 0.25 | 11 | 17.5 |
| 0.375 | 13 | 24 |
| 0.5 | 16 | 31.5 |
| 0.625 | 18 | 39 |
| 0.75 | 21 | 46 |
| 0.875 | 22 | 55 |
| 1.0 | 23 | 62 |

TABLE 2. TIME AND CURRENT USED IN WELDING COPPER.

welders is located on the long iron post to the left of the machine for the purpose of getting it out of the operator's way. This switch is operated by the foot pedal in front of the machine.

At the same end of the machine is also located a regulator. This regulator has a stationary coil at the bottom and a movable coil located above it. By turning the hand wheel shown at the top, the two coils can be adjusted to vary the space between them. This alters the current so it will suit the different sizes of pipe to be welded, as a small pipe does not require as much as a large one.

Another style of regulator that is used by the Toledo Company is shown in Fig.

FIG. 16. RING WELDED AROUND ITS CIRCUMFERENCE

14. This style is used on the largest machines that are built.

The time and electricity used in welding iron pipe are given in Table 3 and from this the cost can be calculated.

### Metals Electrically Welded

Numerous kinds of work and many different kinds of metals have been welded with electricity in the various electrical-welding machines that have been built.

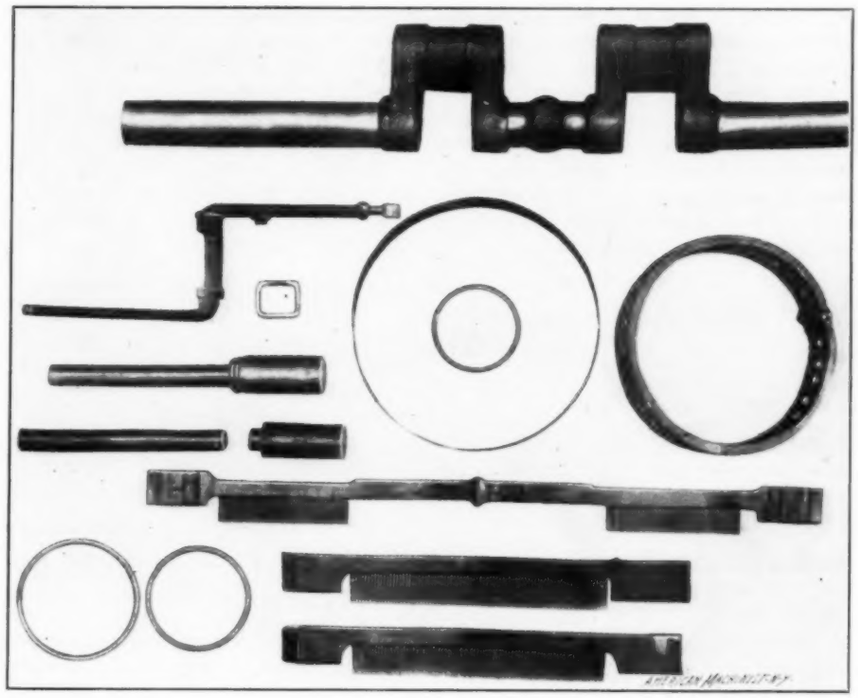


FIG. 17. MISCELLANEOUS SAMPLES OF ELECTRIC WELDING

Most of the machines shown above are standard stock machines, but numerous special machines have been built, most of which are either automatic or semi-automatic. Special appliances can be located on the top of nearly all of the machines shown that will handle all sizes and shapes of work within their limits, and where a large number of pieces of one kind are to be welded, these can be made to work automatically, or either of the companies building these machines will build special machines to handle special products.

The various kinds of pure metals, alloys of metals, and combinations of metals that have been successfully electrically welded are shown in Table 4.

### Welding Tools

A few samples of the various kinds of work which have been performed with the electric welding machines are shown in the pictures that follow. In Fig. 15 are shown some tools that were welded. The three upper ones are a lathe tool that is shown broken, welded, and finished. This illustrates the possibility of welding high-speed steels to machinery steel and thus greatly reduce the cost of high-speed steel tools.

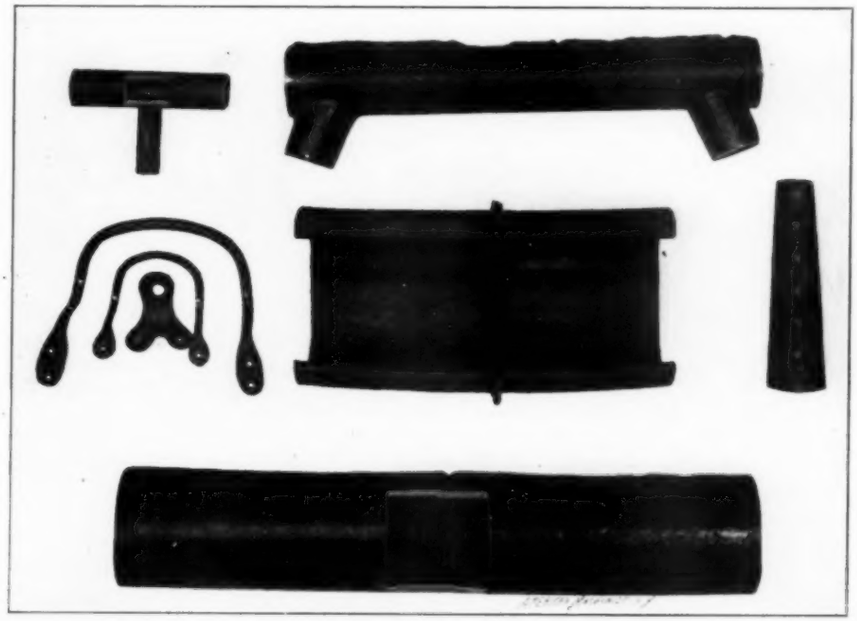


FIG. 18. TUBE AND TIRE BUTT WELDS AND SPOT WELDS

The three middle pieces show a lathe center as it was broken, after it was welded, and after it had been finished; while the three lower pieces show a counterbore broken, after welding, and after finishing.

### Miscellaneous Electric Welds

In Fig. 16 is shown a ring that has been welded on a machine similar to the pipe machine shown in Fig. 13.

In Fig. 17 is shown a miscellaneous collection of samples of electric welding.

The upper piece is two single-throw crank shafts that have been welded together to make a double-throw shaft. This illustrates one of the good features of electric welding, as two pieces can be brought together, when welding them, so they will be the exact distance apart that is required and also in perfect alinement; a feature that is practically impossible with the forge fire.

The piece to the left under the bicycle crank is an example of welding carbon steel to machinery steel. The two pieces are shown before welding and after they have been welded together.

At the bottom of the picture are shown three fallers for combing wool. The electric process of welding is used in the manufacture of these.

The other pieces in the picture explain themselves.

| Inside Diameter in Inches. | Area in Sq.In. | Time in Seconds. | Kilowatts Transmitted. |
|---|---|---|---|
| ¼ | 0.30 | 33 | 7.2 |
| ⅜ | 0.40 | 40 | 8.1 |
| 1 | 0.60 | 47 | 12.1 |
| 1¼ | 0.79 | 53 | 16.5 |
| 1½ | 1.10 | 70 | 24.3 |
| 2 | 1.65 | 84 | 31.5 |
| 2½ | 2.25 | 93 | 47.8 |
| 3 | 3.00 | 106 | 70.0 |

TABLE 3. TIME AND ELECTRICITY USED IN WELDING EXTRA HEAVY IRON PIPE.

**Pure Metals.**

| | |
|---|---|
| Iron | Bismuth |
| Copper | Silver |
| Aluminum | Cobalt |
| Manganese | Zinc |
| Magnesium | Lead |
| Platinum | Tin |
| Antimony | Gold |
| Nickel | |

**Alloys of Metal**

| | |
|---|---|
| All kinds of steel | Gun metal |
| All kinds of brass | Type metal |
| All kinds of bronze | Fuse metal |
| All kinds of aluminum | Solder metal |
| Various grades of iron | Coin silver |

**Combinations.**

| | | | |
|---|---|---|---|
| Copper to | Brass, Iron, Silver, Gold | Wrought Iron to | Steel, Brass, Silver, Nickel, Cast iron |
| Brass to | Iron, Silver, Tin, Copper, Steel, Nickel | Gold to | Silver, Platinum, Nickel |
| Tin to | Zinc, Brass, Lead | Silver to | Platinum, Copper, Gold, Brass, Wrought iron |

TABLE 4. ELECTRIC WELDS ON DIFFERENT MATERIALS.

### Tube and Spot Welds

In Fig. 18 are shown some samples of tube, tire and spot welding.

The central piece is a section of the rim of an automobile wheel, that shows the weld. Electric welding is used quite extensively in the manufacture of these rims. To the right of it is shown a sample of spot welding, while to the left are shown some handles and ears that are to be spot welded to numerous household utensils such as pots, dishpans, etc.

At the bottom is shown some steel tubing that has been welded and a section then cut out to show the texture of the metal in the weld. No difference could be seen between the metal at the weld and that on either side of it which had not been affected by the heat.

At the top is shown a bicycle head, the tube of which was welded along its length. To the left of this is shown a tube that had a bar welded to the side of it in the form of a T. A section of this was also cut out to examine the metal in the weld.

At the left of the top of Fig. 19 is shown a steel type bar that had been welded to a brass bar. In manufacturing these a steel type bar is welded onto each end of a long brass strip and this then cut to make two. Directly underneath is shown one of these that has been bent to show the strength of the welds.

At the bottom of the picture is shown a sheet-metal weld.

In the center is shown a hoe blade that has the tang welded on.

At the top is shown a method of manufacturing sheave pulleys by spot welding. The upper pulley was tested for strength by trying to pull the two halves apart, and it was found that the weld would remain intact while the metal surrounding it would tear apart.

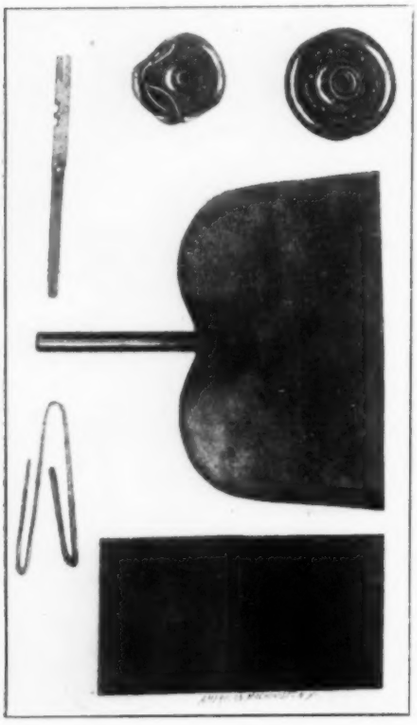


FIG. 19. SPOT WELDED SHEAVE AND BUTT WELDS ON TYPE BAR, HOE AND SHEET METAL

### Chain Welds

In Fig. 20 is shown the development of electrically welding chain. The small piece at the top shows the first method employed. This was to shape the link in two halves, and then butt weld them together at the two sides, thus making two welds in each link. The second method employed is shown in the middle chain. This made but one weld in each link, and that on its side; but it also left two fins one on the inside of the link and one on the outside as shown. It necessarily took considerable labor to remove these fins and, therefore, was not economical. Next an automatic machine was developed which made one weld on the side of each link and no finishing of the chain was required after it left the machine, as no fin or projection was left on it. This chain is shown at the bottom of the picture.

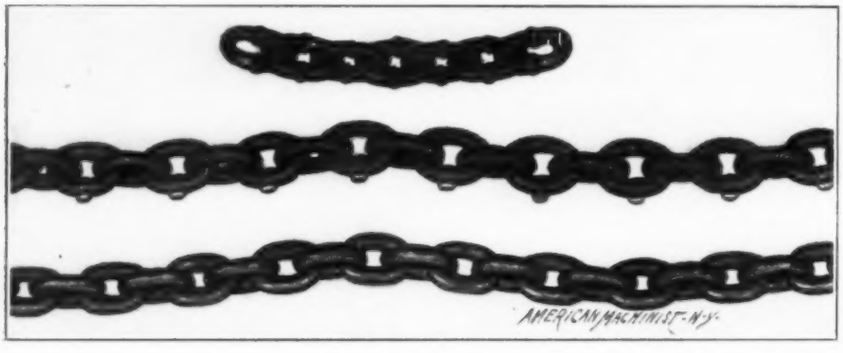



FIG. 20. CHAIN WELDS MADE ON ELECTRIC AUTOMATIC MACHINES

In Fig. 21 are shown some angle welds made with the electric machines. The right middle piece shows a method employed in making wire fence; while at the left is shown a method employed in making bicycle forks. The other pieces explain themselves, and this form of welding is being done commercially every day.

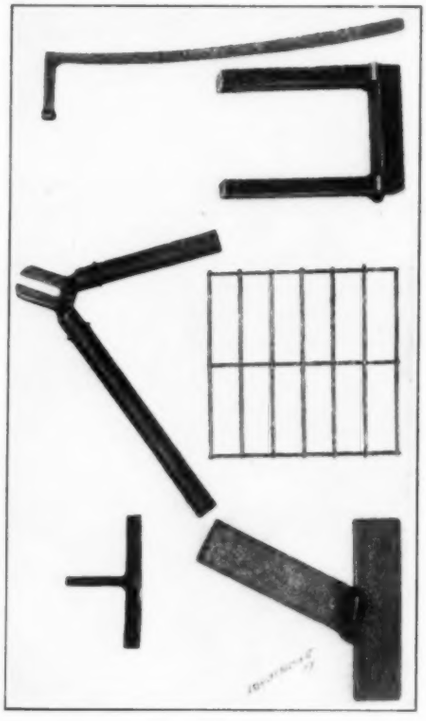


FIG. 21. BICYCLE FORK WELDS AND WELD MADE AT AN ANGLE

In Fig. 22 are shown two bending tests which were given electric welds. The lower piece is steel that was welded in two places and then given a very short bend at one of the welds, with no signs of a fracture appearing. The upper piece is brass rod that was welded together, and this likewise was given a very short bend right at the weld, showing that for nearly all practical purposes the welded section is as strong as the original metal.

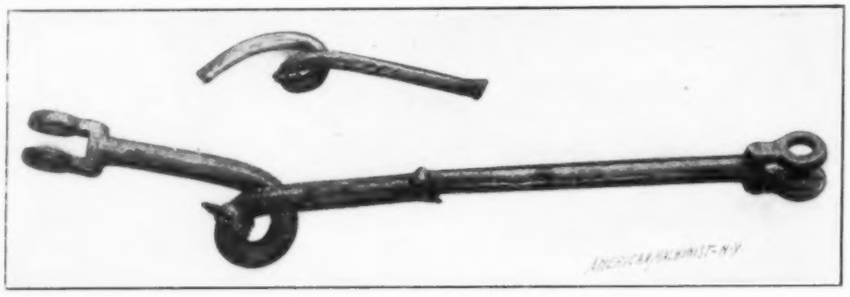


FIG. 22. BENDING TESTS OF BRASS AND STEEL WELDS

### Advantages Obtained by Electric Welding

These electric machines illustrate the principles on which the resistance machines are based and run and as electrical power is available nearly everywhere, their installation is not difficult. Where electric power is not available, special generators can be put in and run at a small cost.

Some of the advantages that this form of electric welding has over the forge fires are:

The heating is practically confined between the two clamping jaws which is a distance varying from ⅛ to 2 inches according to the size of the piece to be welded, and there is no scaling or blistering on either side of the weld.

The waste of material is only that required for upsetting enough to insure that intimate contact is obtained and all overheated stock forced out.

Stops or gages can be located on the machine to make the work accurate to its required measurements and hold it in perfect alinement.

The center of the weld is as perfect as the outside, owing to the fact that the heat is uniform throughout the metal in the welded section, and air does not come in contact with the welded surfaces to cause oxidation.

Absolute control over the heat can be obtained as, by using simple appliances, the metal can be held at any temperature desired for any length of time and the heat increased or decreased at the will of the operator.

The operator is in no danger from electric shock and the weld is made almost instantaneously on small sections, while on large sections but little time is consumed.

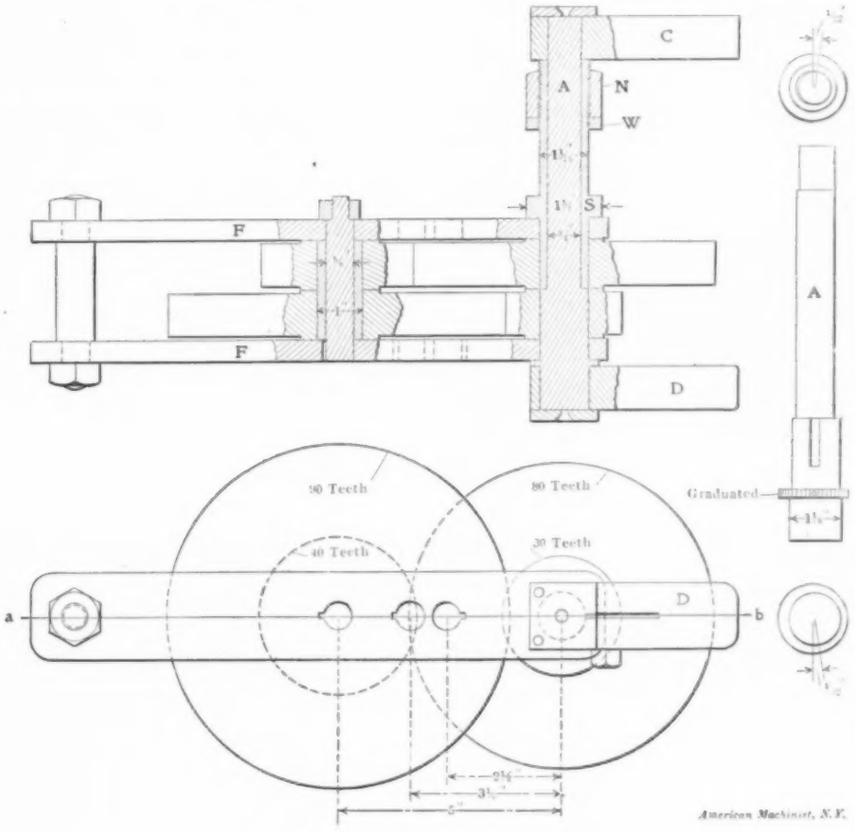
The machines make practically no dirt or smoke, and the apparatus can, therefore, be used in any convenient or desirable place.

The work is visible at all times and the welds are very strong, as the metal in the welds is nearly as homogeneous as that of the original metal, and the structure of the metal at the joint is the same as elsewhere.

## A Simple Backing-off Device

By Martin H. Ball

The relieving device shown was devised to meet the requirements of relieving milling cutters, hobs or taps. The gears are all lathe change gears, and the other parts are as far as possible made from stock size of cold-rolled steel. The sleeve upon which the second and third gears of the train are locked is also a lathe part, being used on the intermediate stud for compounding. A 30-tooth gear drives a 90-tooth gear which is locked to the 40-tooth gear through the sleeve shown and in turn drives the 80-tooth gear on the sleeve that carries the work to be relieved. This has six teeth in this case. Nine teeth can be relieved by using the 20-60-20 and 60 gears and four teeth by using 20-40-20 and 40 gears. The eccentric arbor has a graduated collar. When the zero mark on this coincides with the line on the driver *D*, the centers in *D* and the adjustable center *C* are concentric with the arbor *A*.




A SIMPLE BACKING OFF ATTACHMENT

Make arbor *A* and parts *C* and *D* complete except the holes for the lathe centers and the mark on *D* to read the graduations from. Assemble with the adjustable center *C* and driver *D* parallel. Clamp them to the arbor and make the holes for the lathe centers and the mark on the driver *D* to read the graduations from while thus assembled. The caps on *C* and *D* are each fastened on with two rivets as shown, placed in one end. The opposite end is left free that it may not interfere with the clamping action on arbor *A*. The sleeve *S* runs freely in frame *F* (as does arbor *A*), and has the last gear of the train keyed to its end. A collar is placed near its center against which the work is clamped by the nut *N* and washer *W*. All these parts turn freely on arbor *A*.

The projecting ends of the frame *F* rest on the lathe bed or carriage and the driver *D* is driven by a stud on the lathe face plate. The adjustable center *C* is made long, as shown, for convenience in setting.

After the blank to be relieved has been secured in place by the nut *N* (and a key in sleeve *S* if necessary) the driver *D* is set to the required throw and locked to the arbor, then the adjustable center *C* is placed parallel with it and locked. This can conveniently be done with two parallel strips, on a surface plate, planer, or other machine table. Cutters with cutting sides may be relieved by throwing over the tailstock of the lathe. When this is done, however, the spacing will not be exactly even and would not do for first-class work.

The relieving of taps and hobs for worm gears can be done by gearing the lathe to cut the lead of the tap or hob multiplied by the number of teeth. For example, to relieve a four-lead tap with four flutes. Gear the lathe to cut 16 per inch. In milling out the flutes which is the last machine operation, it is best to set to cut far enough back of the highest point to make sure that the cutting edges of the teeth being made are sufficiently backed off. The backing off is very slight near the highest points and is greatest about midway between the highest and lowest points.

According to the report of the Interstate Commerce Commission, railroad accidents for the first three months of the present year show a total death list of 663, while 15,122 persons were injured. This is a substantial decrease in the number killed as compared with the same period last year.

# Standard Machining Elements and a Machine-rental Plan

By Leroy Tabor

The various comments on rate setting and what shall the premium be, recall many pages of experience in regard to this matter, also several cases of unpleasantness between employer and employee.

My earliest experience was in the eighties. I remember one day in August when I started my ship on the sea mechanical. There was a serious disturbance that day owing to notices posted in various parts of the shop, if I remember correctly, reading: "Owing to present conditions of business, employees will be expected to run two or more machines as circumstances will permit." All work was done by the day. I believe the cause for this notice was due to sharper competition, also depletion of the treasury caused by moving from an adjoining town. It is unnecessary to add that after several men quit, and a few got "fired," the order went into effect.

Things went along in this state for a short time, then piece work was inaugurated. I suppose I should feel highly honored to think a youngster with about one year's experience should have had the honor (?) to assist in this revolutionary movement. My duty, however, was unimportant. I went around the shop with the chief draftsman and superintendent, to drag out the various jobs for inspection, and to weigh them; also to answer questions in regard to about how deep cuts and how heavy a feed Bill or Jake used on this or that piece; also if they did much visiting with the other men. I could do no more than answer their questions, but at that time I felt like a spy. At any rate, rates were set by this method and back records.

The deductions were on the safe side and things ran quite smoothly. I believe the men learned the maximum wage allowed without cutting in about two weeks. Another point was also apparent: No matter how much or how little the second machine did, if kept running this allowed them to raise the ante one dollar per day. Later a change was made in foremen, and the new man had very different ideas. Piece work was abandoned; also the two-machine idea. I cannot say what effect this had on the amount of work produced, but it was clearly understood that each man had to keep up his pace or get "fired." This period lasted about one year. Then a graduate under the head draftsman acted as general foreman, and later divided the work. I understand he became superintendent later and took the entire shop by contract, and sub-let it to two men who acted as his foremen. This was the first time the shop had been really alive for several years.

Under this method, and persistent following up and noninterference, I believe this plant produced more work per man than any similarly equipped plant of that period. Later a change was made in management, coupled with general "butinsky" and general distrust on both sides; piece work was restored and rate cutting and periodical cases of unpleasantness finally caused a suspension of business.

I have tried piece work with very good results when the piece was gone over with each operator, and an agreement made that the price would stand over a given period. I have also tried the premium plan and used a rate setter in the shop, also in a department for this purpose. The results were considered excellent until a careful study and record of each job proved that some men could earn their premium in six to eight hours, while others were always hard pressed for time. As an extra inducement operators were allowed to go home when they "made their premium." This afforded some relief, but failed to pull up all of the laggards. A change of men helped matters a little, especially if men changed were at loggerheads. Later we adopted another feature: Straight premium of 20 per cent. ceased at a certain point, and the man received full benefit of his extra exertions. We also arranged a fixed time through which a premium should run; at its expiraton the premium was to be readjusted.

## A Suggested Machine-rental Plan

This latter arrangement proved very satisfactory, contrary to our expectations. My experience with this method has stimulated thought along this line, and I suggest payment of an abnormally high piece price, and rent the machines to operators for a given price per hour based on the productive capacity of the machine. I have made a table using decimal time and assumed machine and man rate carrying both sides to zero.

My intentions are that this will be a strict contract or machine-rental plan with no guarantee of a certain day rate, but to make the time on the work as nearly correct as possible and let the operator receive additional pay for each tenth he reduces the time, by the reduction in amount he pays for use of the machine. If he overruns the time he is the loser in exactly the same proportion. I have applied this table to jobs in current shop work where rates were quite accurately set; its influence could not be determined as it was used as a dummy to see about how it would work in actual practice. The average results are very satisfactory to me, but I believe if it were put in actual practice it would appeal to any operator as being absolutely fair and that he got what he earned whether it was on the ascending or descending side. One of the greatest aids in producing the greatest amount of work in a given time is a mutual understanding and confidence on the part of employer and employee.

My experience in regard to rate setting, or estimating time required to do work for contract jobs, has proven to my satisfaction that under ordinary conditions there will be as many different rates as there are rate setters for the same piece of work. I believe rate setting from standard elements to be the only solution. F. W. Taylor has demonstrated this so the doubtful ones need have no fear as to its practicability and efficiency.

## Why Not Compile Standard Rate-setting Elements?

I cannot understand why the manufacturers in the machine line do not form a pool and put enough money at the disposal of some one competent to take and compile all the standard elements that would be required for scientific rate setting for years to come. A copy of such data would be almost invaluable and could be used in any plant if standard tool symbols were adopted.

As I see it, there are two kinds of time study: one by observation taken with stopwatch for compiling, the other a study of combinations of elements after they are compiled to determine the most rapid method of attaining the desired results. Time study requires but three grand divisions: that is, labor, which should cover all hand operations where tools are not required; machine, which should cover all manipulating time for the machine and be for a specific type; tools, which should cover handling or manipulating by hand. When making up a rate if a certain tool is to be used one can readily turn to the tool symbol, if the elements are properly compiled, and under the symbol of the tool find time for its use; the same statement holds good in regard to the machine or labor elements, the cutting time in all cases to be computed by the slide rule.

## Use of Standard Elements in Rate Setting

When conditions are such as to permit the use of standard elements for rate setting, the results come quickly if sufficient inducement is given the operators. To make it clear in regard to when conditions will permit the use of standard elements, I mean that tools, machines and belting must be kept in dependable condition, that work and tools, also all necessary information, conveniently placed at the machine or vise in time to prevent delay; also that finished work be removed so the operator does not have to climb over it when performing his duties. The rate setter must be a high-grade man and a thorough mechanic and know what is

necessary to be done to complete the job under consideration to specifications. Standard elements in the hands of a "dub" are about as ridiculous as a ball gown on a pig.

### Use of Cards and Memorizing Standard Elements

If instruction cards are made out when the rate is set, and sent into the shop with a drawing and tool list, if the job is complicated in chucking, or handy men are utilized as operators, a rough sketch showing the method of chucking will be found to be a time saver. If the question arises in regard to rate it is easy to "check up" the various elements to see that none are omitted. Personally I believe in checking all cards that are apt to be repeated. If a speed boss is employed, this should be one of his duties. If the time is questioned the rate setter does not have to expend an hour or so arguing the various points; he has his standards and can produce his authority for an element or the entire card at once.

When new men are employed it is a good plan to prove the card to them. When this is done it should be proof of *elements*, not of the entire card. The part to prove is that the foundation is correct. When this has been done a few times and he is convinced that your standards are correct, there is but one thing for him to do, get busy and "make the time." He will feel that the rates are to be relied upon and are not a conglomeration of guesses, the product of several brains or the results obtained by some special operator used to set rates under the most favorable conditions.

It is surprising how quickly a first-class rate setter will memorize standard elements. He will not have to consult his standard sometimes for several days. Several times I have questioned elements set from memory and on reference to standard data found them correct. All workmen, including myself, have peculiarities and do things that are unnecessary, and would continue in this direction until the end of time, unless it were proved to us they were superfluous. Great savings are often accomplished by avoiding unnecessary moves. Rate setting from standard elements removes the unnecessary elements and directs all of our energies into efficient channels.

| Number of Pieces. | Time, Hours. | Machine Rental, Cents. | Man's Earni'gs, Cents. | Price per Piece, Cents. | Number of Pieces. | Time, Hours. | Machine Rental, Cents. | Man's Earni'gs, Cents. | Price per Piece, Cents. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.0 | 50 | 40 | 90 | 1 | 0.9 | 45 | 45 | 90 |
| 1 | 1.1 | 55 | 35 | 90 | 1 | 0.8 | 40 | 50 | 90 |
| 1 | 1.2 | 60 | 30 | 90 | 1 | 0.7 | 35 | 55 | 90 |
| 1 | 1.3 | 65 | 25 | 90 | 1 | 0.6 | 30 | 60 | 90 |
| 1 | 1.4 | 70 | 20 | 90 | 1 | 0.5 | 25 | 65 | 90 |
| 1 | 1.5 | 75 | 15 | 90 | 1 | 0.4 | 20 | 70 | 90 |
| 1 | 1.6 | 80 | 10 | 90 | 1 | 0.3 | 15 | 75 | 90 |
| 1 | 1.7 | 85 | 5 | 90 | 1 | 0.2 | 10 | 80 | 90 |
| 1 | 1.8 | 90 | 0 | 90 | 1 | 0.1 | 5 | 85 | 90 |

ILLUSTRATIVE TABLE OF WAGES AND PIECE COST BY MACHINE-RENTING METHOD.

## Are We Neglecting Vertical Planing Machines?

By Andrew Robertson

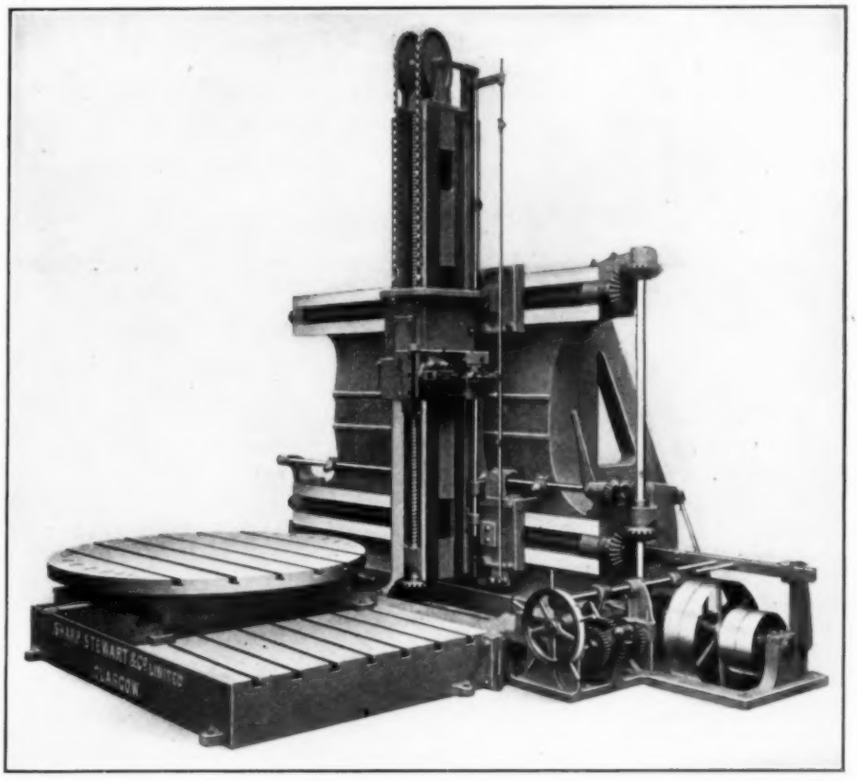
There is one marked difference between American and British practice in the machining of heavy work. I mean the apparent scarcity of combined horizontal and vertical planing machines. This type of tool has been found of value in this country on general as well as marine work, and I would like to know why it does not find favor in American shops. It is not intended for the machining of such parts as lathe and planer beds, but rather to frames for slotting machines, vertical mills, punch presses, steam hammers, engine sole plates, turbine casings, roll housings, etc., where the surface to be machined is small, and the time occupied in setting the work bears a close relation to the tooling time.

The illustration shows a machine of this type made by Sharp, Stewart & Co., which planes within an area of 9 feet horizontally, and 10 feet vertically. The circular table adds considerably to the capabilities of the tool. The principal advantages it obtains over the horizontal type of planer, for the class of work mentioned, are:

The small amount of power expended in cutting and reversing. This power is almost constant, and is never excessive at the reversal, as the saddle which carries the tool is balanced. In comparison with the power expended at the reversal of a massive piece on the heavy table of a horizontal machine, this economy is considerable.

A considerable amount of floor space is saved, as the work remains stationary. These two advantages are of such moment that one wonders why machine-tool builders have not faced and solved the problem of the high-speed horizontal planing machine where the table is stationary and the tools reciprocate.

A tool which appeared to be a good effort in this direction appeared in your paper recently, and it seems a pity that the idea has not been further developed.




AN INTERESTING SCOTCH VERTICAL PLANER

As an example of Chinese awakening in scientific research the Chinese authorities are proposing to establish an observatory somewhere in Canton and to engage an astronomer. Plans are being prepared for its construction, and funds are being collected for the purchase of the necessary apparatus.

# The Greatest Bakery in the World

## Connellsville Region WhereCoal Is Baked into Millions of Dollars Worth of Coke to Feed Hundreds of Iron Furnaces. Millions Go up in Smoke

BY GEORGE FREDERIC STRATTON

In the State of Pennsylvania is a bakery comprising 30,000 ovens requiring the services of 25,000 bakers and helpers, and turning out over 300,000 tons of product each week. To handle the materials and the product requires nearly 4000 horses and mules, over 500 steam boilers, 100 locomotives, more than 400 stationary engines, upward of 15,000 cars, and over 1000 miles of private tracks.

This bakery is known as the Connellsville region, and the product is coke—not bread and pies.

More than one-half of the entire coke production of the United States is from this district. Beneath its surface lies what is claimed to be the finest coking coal in the world. Upon the surface are the greatest and most elaborate plants for converting, handling and shipping in the world. The natural advantageous trend of the underlying coal veins has been so cunningly utilized that, in many cases, the mineral goes from the pick to the oven in 10 or 15 minutes. A car loaded at the vein is hauled out by little electric locomotives, and a few minutes later its contents are dumped through the roof opening of an oven—already at a high temperature—and the baking at once commences.

Connellsville coal is bituminous and possesses the qualities for making a high quality of coke; the fuel which has built up the gigantic iron and steel industries of the Allegheny valley, which has placed the United States at the head of all iron- and steel-producing countries, and which, as recently stated by Mr. Carnegie, has helped to reduce the cost of manufacture to a lower point than that of any other country.

All honor, then, to the good, gray coke, and to Connellsville, for it was here that the industry had its birth. In 1816 Col. Isaac Meason built the first rolling mill of the United States in the Connellsville district, and three years later he used coke for heating. But it then met with small favor, for we hear nothing more of its use until 1843, when Mordecai Cochran, a farmer, made another attempt to introduce it. Cochran owned 300 acres on the Youghiogheny river, and under every acre was coal—soft coal which no one wanted. But the farmer was shrewd and thoughtful, and of a scientific turn of mind. He dug out 100 tons of the mineral, coked it in earth-covered mounds as charcoal was then burned, and with the help of two neighbors built a couple of flatboats—cutting the timber on his own farm. He then floated the coke-laden boats down to Cincinnati and sought in vain for a customer.

As a last effort he told a foundryman, Miles Greenwood, that if he would send teams and haul out one boatload of the coke and try it, he could have it for nothing. Somewhat reluctantly Greenwood consented, and was vastly astonished at the results from the new fuel. In its melting power and in the quality of the castings produced it was superior to coal or charcoal. That was the introduction of coke to the few foundrymen of the country.

But there were men in those days, as in all days, who would denounce an innovation without taking any steps to demonstrate the correctness of their opinions. Coke suffered from these obsessions and grew in favor very slowly. A dozen years elapsed before it superseded charcoal, and another 20 years passed before anthracite coal gave way in its favor. So little importance was attached to its manufacture that figures regarding it are not obtainable from United States Census reports prior to 1880. In that year the total value was placed at $5,359,489, with no by-pro-

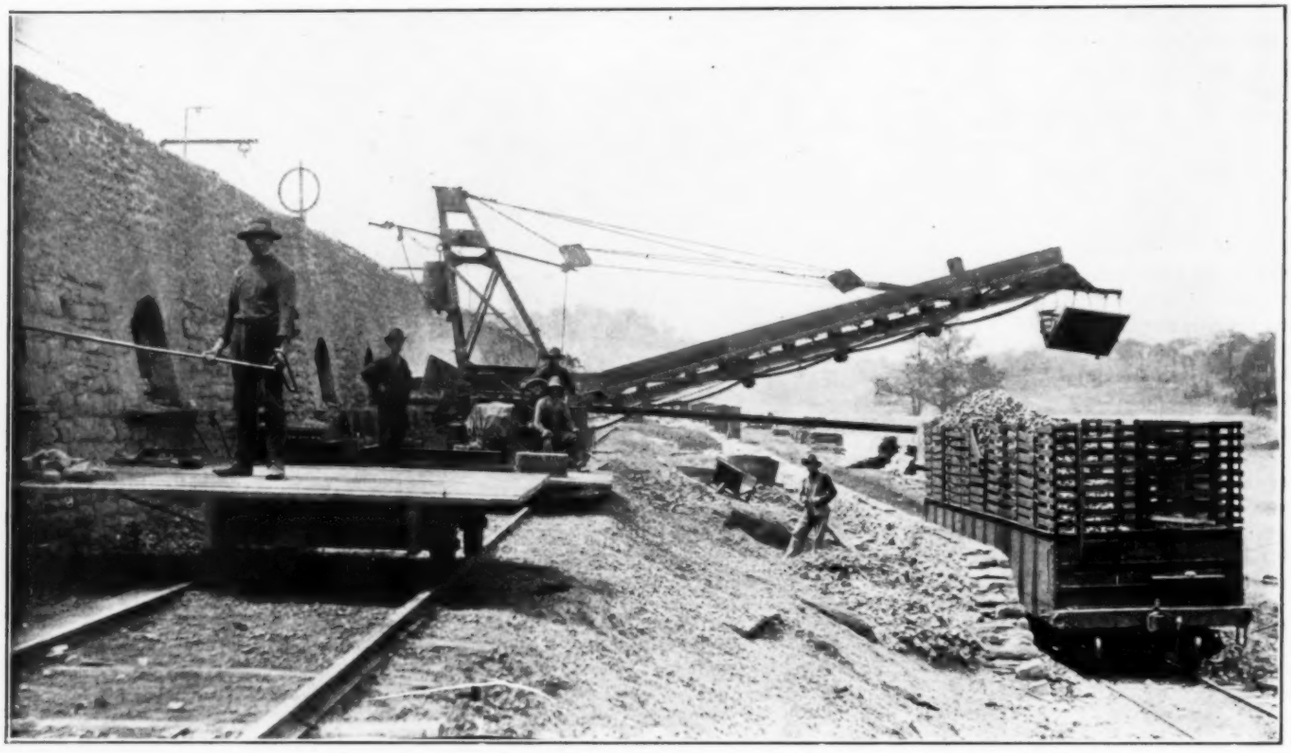


FIG. 1. COKE DRAWING AND LOADING MACHINE. COVINGTON MACHINE COMPANY

ducts. In the last report, 1905, the value of coke production had risen to $50,504,623, and that of by-products to $3,150,485. It is estimated that an increase of 30 per cent. has been made since then.

An interesting contrast to the experience of Mordecai Cochran, in selling coke, was shown in 1903, when the price rose suddenly from $2 per ton, at the ovens, for furnace coke, to $3.50 and $4, and for foundry coke it rose from $2.75 to $5 and $12 per ton. This was due, not to scarcity of the fuel, but from scarcity of cars to haul it. Nearly 1,000,000 tons were piled outside the ovens, for months, waiting for transportation to the great blast furnaces and mills of Pittsburg and vicinity.

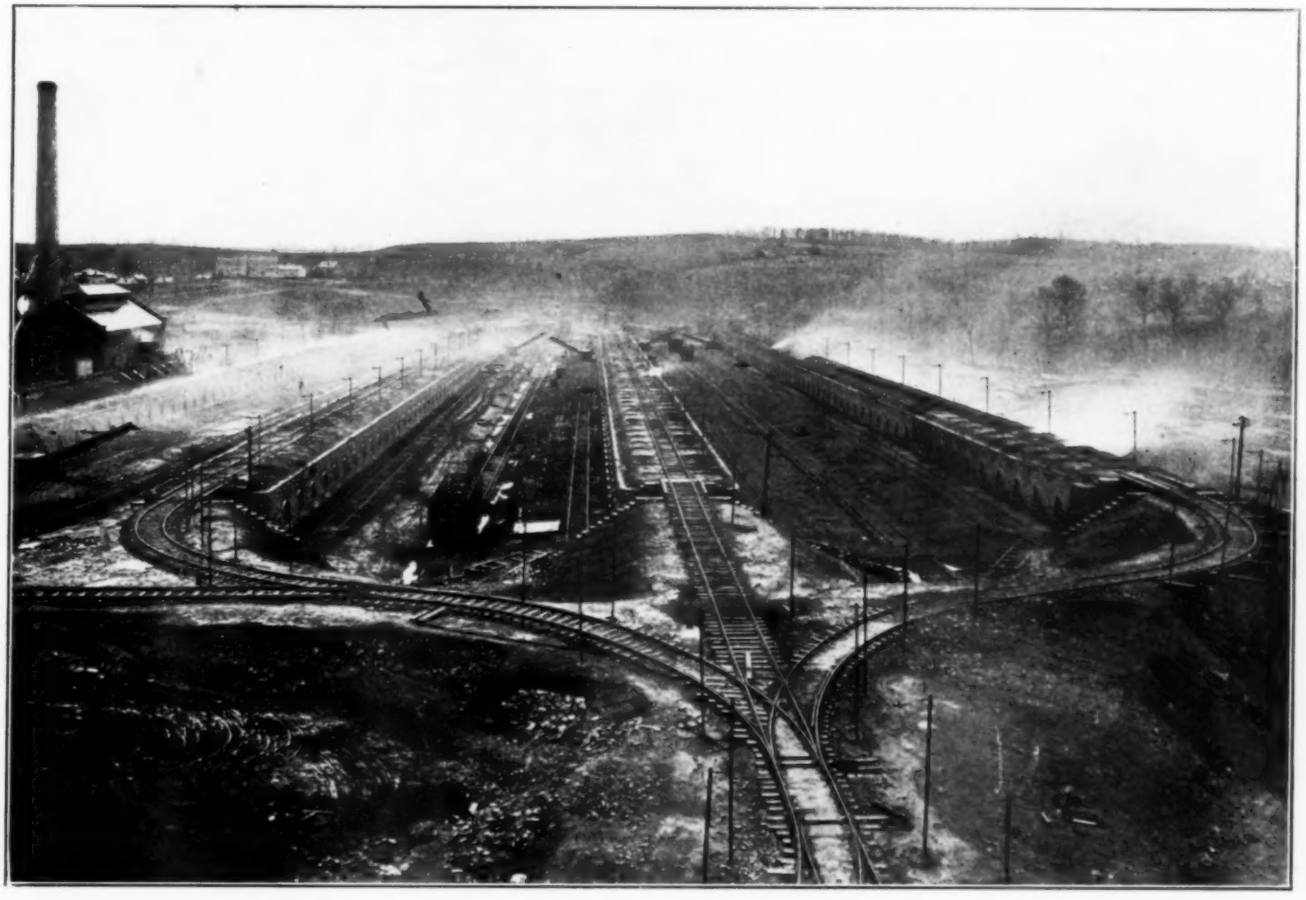


FIG. 2. PHILLIPS PLANT OF H. C. FRICK COKE COMPANY

Making coke is not an attractive industry. Each ton of coal gives off, in coking, 10,000 cubic feet of gas, a large proportion of which escapes into the smoke. It also yields 120 pounds of tar and 200 pounds of ammonia, which also goes up in smoke. Multiply these figures by 150,000—the number of tons of coal baking each day in the ovens—and the resultant atmosphere of the Connellsville valley may be faintly guessed at.

At night the scene is diabolically weird. From thousands of ovens flames are leaping viciously, 30 and 40 feet high, lighting up the swirling billows of smoke with blotches of yellow and brown, with inky-black cavernous shadows. Every minute or two, as the heated coal in some newly charged oven reaches the combustion point and the accumulated gas ignites, the explosion sends a shower of sulphurous sparks and wicked-looking tongues of flame, high above the surrounding masses of smoke and the steadier fires.

Day and night, weekday and Sunday, this pandemonium of wildly dancing lights and shadows of flame and fume continues, for the ovens are never allowed to cool off—excepting for repairs.

Connellsville coke is made almost entirely in what are termed beehive ovens. These have a conical-shaped interior, usually 12 feet in diameter and 8 feet high. At the top is an opening for the introduction of the coal and the escape of gases. At the lowest level of one side is an opening for withdrawing the coke. The ovens are built in long, double rows, back to back, and closely adjoining each other. Over the tops and between the double row of charging openings is a track upon which the mine cars bring the coal.

The double rows of ovens are set from 60 to 80 feet apart, and in this open space are usually three tracks. The center one, of standard gage, carries railroad cars in which the coke is shipped out. On each side, close to the oven doors, are the trucks carrying the drawing and loading machines.

The operations are simple. Some of the coal veins are so favorably situated as to enable the hauling out of the mineral by slopes instead of hoisting shafts. The mine cars are run directly over the ovens, and the contents dumped into the charging openings. As no time is lost in recharging after drawing the coke, the oven is still very hot, and the heat is intensified by the practice of drawing alternate ovens; every newly charged one being thus joined on three sides by others which are in action, and at very high temperature. The lower opening is bricked up, leaving but a small aperture for air entry. Within a short period the mass of new coal becomes so hot that combustion suddenly commences; the accumulated gases exploding and rushing from the overhead aperture with a roar and dash of flame. After some time the combustion settles down to a flickering flame over the surface of the coal.

The baking continues for 48 hours, except for the Friday chargings which are left in until Monday, making 72 hours, and eliminating Sunday work. These charges are known as "furnace coke" and "foundry coke," respectively; the 72 hours baking producing a stronger, closer-grained fuel which is desirable for sustain-

ing the heavy weight of the pig iron used in foundry operations. When the coking is complete the brick facings are torn from the side openings and the mass of glowing coke is thoroughly quenched with water, by means of the long nozzle of a hose. It is this sudden bath of water which gives the peculiar and rather attractive, sparkling, silvery appearance to coke.

The drawing machine follows immediately after the hose. It is an elaborate and very ingenious apparatus, perfected after much costly experimentation. On the carriage frame is a powerful ram, equipped at its extremity with a chilled, cast-iron shovel, thin at the front edge and eight inches thick at the back, which serves as a wedge. The length of the ram and the power employed are sufficient to force the wedge shovel in under the coke, to the back of the oven. It is then withdrawn with its load of steaming fuel, which falls on the conveyer and is screened properly from ash during its travel over to the railroad car.

Not all the oven groups are equipped with these machines; a large number being still drawn by hand labor. This is about as severe and exhausting work as stoking on a battleship; the intense heat of the adjoining ovens being supplemented by the steam from the newly quenched coke, and by the fumes from stray gases. But the enormous economy of the machines is bringing them into general use—coupled, also, with the difficulty in obtaining men to face the very unpleasant conditions. At a drawing test of three thousand ovens recently made, where the piece-work price for drawing and loading by hand was $1.05 per oven, the machines did the work at a cost of 40 cents per oven—a fact which will very quickly eliminate hand labor on such operations.

About the year 1890 thoughtful men commenced to gaze at the tremendous masses of yellow, brown, and black smoke constantly emitted from the ovens; and to collect figures in note books. In that year the value of all the by-products saved in the manufacture of coke, in the entire country, was less than four thousand dollars; while the by-products which were going up in smoke were worth over twelve million dollars. In Belgium and Germany coke by-products had been rather extensively saved for some years, and exact figures of their value were obtainable.

The figures in the note books aroused men to action. Within two years the first battery of by-product ovens in the United States was put in commission at Syracuse, New York. Others quickly followed at various points, so that the census reports of three years later (1905) gave the value of the saved by-products as $3,150,000, and the possible value, if all coke had been made in the improved ovens, as $36,000,000. And, although a great number of by-product ovens have since been installed, the waste of good illuminating gas, coal tar, and ammonia is still enormous. In the Connellsville district very few of the improved ovens have, as yet, been substituted for the old beehives, and the flaming clouds still roll heavenward, consuming thousands of dollars' worth of good material every twenty-four hours.

Every year Connellsville sends up in smoke the approximate value of the buildings and furnishings of a town of ten thousand inhabitants.

One of the most interesting plants in the country for getting every cent out of the coke industry that there is in it, is that of the New England Gas and Coke Company, on tide-water, at Everett, Massachusetts. At this plant is made nearly a million tons of coke, yearly; most of the coal being brought from New Brunswick, in the company's own vessels. About one-half the product is sold to railroad companies for locomotive firing, the other half is devoted to foundry and domestic use.

FIG. 3. ANOTHER VIEW OF COKE DRAWING AND LOADING MACHINE

The coke at this plant is handled by most approved methods, and by the highest type of apparatus. It is thoroughly cleaned, crushed and screened into sizes corresponding to those of anthracite. After an up-hill campaign of education it has been introduced as a fuel into a great number of homes, and although requiring a slight degree more care than anthracite its economy and efficiency are inducing a very large use for both furnace and stove.

Every particle of by-product is saved, at this great plant—the largest of its kind in the country. The gas is piped to Bos-

ton and to eleven surrounding cities, where it is purchased by the local gas companies and by them treated, stored and delivered through their own mains to their customers. The tar and chemicals are recovered and commercially handled in the most systematic and scientific manner.

The total value of all the coke and by-products made in the entire country is now estimated as being seventy millions of dollars, yearly; while the possible value if all the by-products were saved is one hundred and twenty millions, showing a waste of fifty millions of dollars. This regrettable figure will, undoubtedly, decrease hereafter very quickly; one of the great factors in impelling the decrease being the gas engine. Many of the great foundry companies have installed by-product coking-ovens, by which they make their own coke for melting, use the gas for power, and save the chemicals. The most astounding preparation for the utilization of waste gases is at the great steel plant at Gary, Indiana, now approaching completion. Although very little coke will be made there, as the coal will be burned in the blast furnaces, the resultant gas from those furnaces will be used to run thirty-three 3000-horsepower gas engines, beside making steam for heating the great plant. The tremendous power required for running the capacious rolling mills, with their numerous auxiliary components, is to be obtained from what would otherwise roll wastefully to the skies.

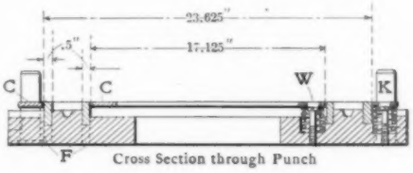
It is a safe prophecy that Connellsville will be reformed. Its foul incense will be captured and washed, and put to work behind the pistons of massively constructed engines. The deadly fumes from the daily consumption of three thousand tons of coal will quietly and unobtrusively turn every wheel of the greatest unified, industrial plant on the globe—will be headed up in six hundred tar barrels, and three hundred other barrels, branded Ammonium Sulphate.

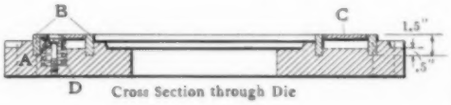
## Sectional Blanking Tools for Electrical Work

By Emil Klaps

Although I have been a reader of the American Machinist for many years, I cannot recall having seen a die produced as here shown. It is of the sub-press type. Punch and die plates *A*, as shown in Figs. 1 and 2 in plan and section, are of cast iron, on which are cast four lugs for guide pins *K*. The plates are machined and grooved to take the die and punch rings *B*. These grooves must be turned very accurately, as there are no screws for holding the rings to the plates. The rings *B* are made in segments of bar steel (high carbon 1⅝x⅝ inch) and bent to a given arc. Before turning, each segment is machined on top, bottom and ends, these having to join together so as to build up a ring. They are then clamped down to a cast-iron plate, and chucked in a lathe as shown in Fig. 3. Each segment is held to the plate by two clamps, and located by two studs, which carry set screws. These studs must be a sliding fit in the plate as they are reversible, for turning the rings both inside and outside, it is necessary in turning these rings to make them a solid, snug fit, so allowance must be made in the diameter in turning, first to allow for shrinkage in the length of the segment in hardening, for which I allow an increase of 0.125 inch on the diameter, and second, for grinding to size. The increase for grinding is on the cutting-edge diameter, for which I allow 0.03 inch, as you will note in the cross-section, in Fig. 1, the section of the ring *B* is 0.5 inch thick on the top when finished, so it is increased for grinding to 0.515 inch. This size has to correspond with the grooves in the cast-iron plates *A*, which receive the members of the rings after hardening. The segments are driven home to the bottom of the grooves, which form the only hold for the rings, which are now ready for grinding to size. The key and a keyway *G* have to be machined before hardening the segments. To drive the members of the rings out of the grooves, two holes *F* for each segment are drilled in the cast-iron plates *A*. The strippers *C*, which are of mild steel, are held in position by the screws *W*, and operated by compression springs, shown in enlarged cross-section, Fig. 4. After grinding the rings at top and bottom the tools are put together, so that the guide-pin holes *E* can be drilled and reamed, and the pins *K*, which are of mild steel, case-hardened and ground, are driven in the plate as shown in section *W*, Fig. 1. As noted on the drawing, Fig. 1 is the punch, and used in this case as the bottom tool.

This class of tools is doing very good work, and is cheap to manufacture.



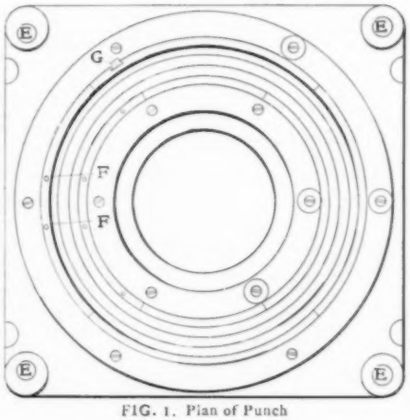




FIG. 1. Plan of Punch

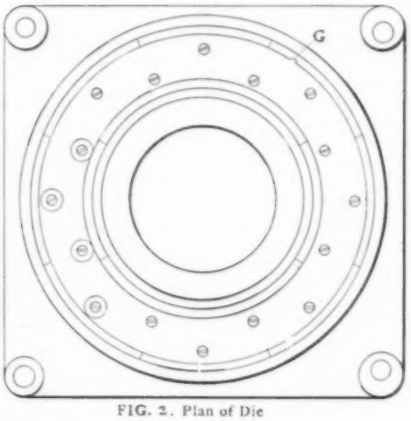



FIG. 2. Plan of Die

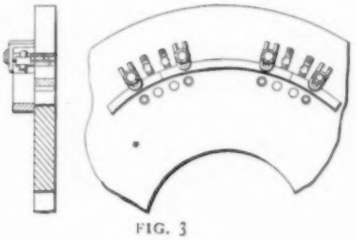


FIG. 3

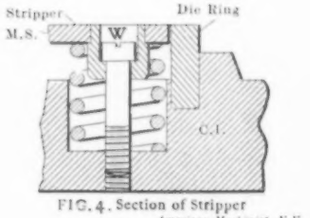



FIG. 4. Section of Stripper

American Machinist, N.Y.

SECTIONAL BLANKING TOOLS FOR ELECTRICAL WORK

# Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

## WE PAY FOR USEFUL IDEAS

### Some Points Regarding the Traverse Spindle Grinder

The traverse-spindle grinder is essentially a watch-factory tool, but as the bench lathe and its equipment are now found in nearly all uptodate tool rooms, these few pictures of simple operations, intended merely to show the facility with which a single piece may be held and ground inside and out, may prove of interest.

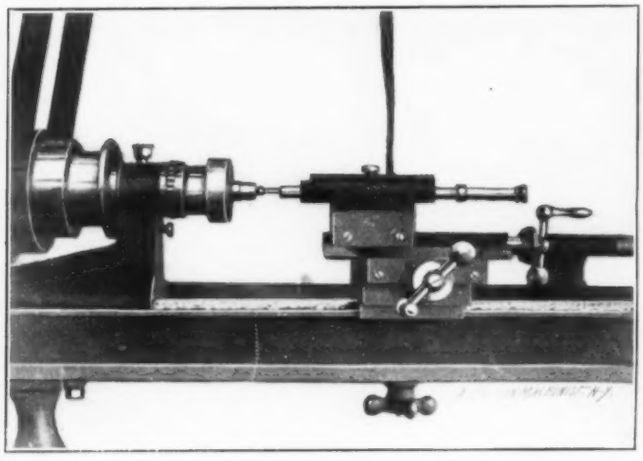


FIG. 1

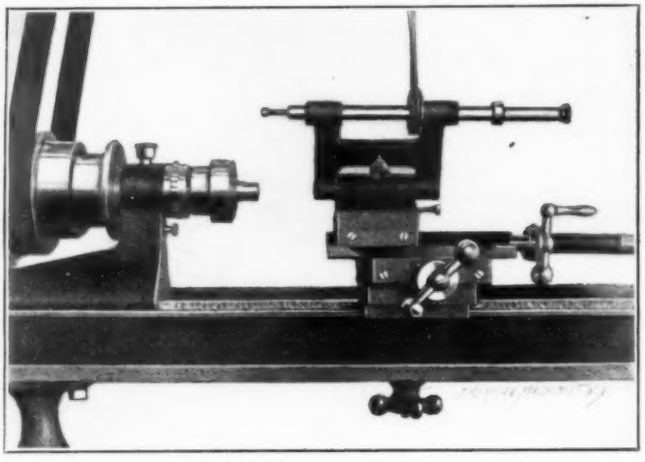


FIG. 2

TRAVERSE SPINDLE GRINDER ON INTERNAL WORK

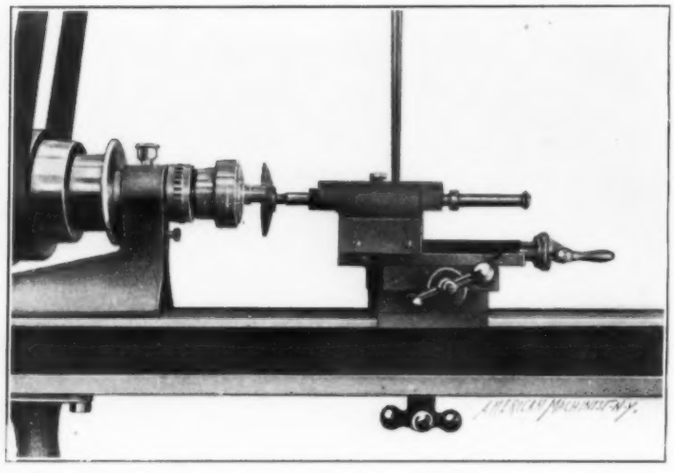


FIG. 3

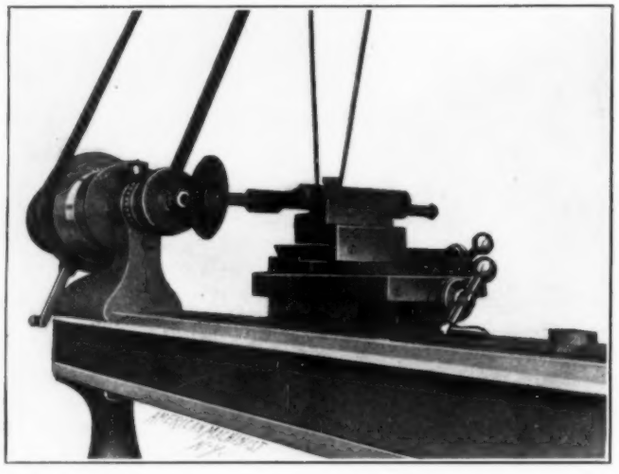


FIG. 4

TRAVERSE SPINDLE GRINDER ON EXTERNAL WORK

Fig. 1 shows the work held in a cast-iron spring chuck, with a closer on the spindle and a small wheel in position for grinding the hole. Fig. 2 shows the spindle swung back to allow the hole to be gaged. This is a good feature, as it allows plenty of room and the wheel swings back to exactly the same position when locked by the small pin, shown pulled out just below the fulcrum pin.

Fig. 3 shows the 3-inch disk wheel which will grind the diameter and face the shoulders of the work, or the rest may be placed on the offset shoe which is fastened to the back T-slot, as in Fig. 4, and brings the spindle at right angles to the head spindle. Although these grinding fixtures seem light and delicate to the uninitiated, I have seen holes in 4-inch rings ground with them where 0.01-inch stock had to be removed, in one-half the time it took to do the same job on a universal grinding machine. The traverse spindle, when properly fitted, will run without a particle of oil, if kept clean, and it is common practice to use it in this way.

Use clean tissue paper and alcohol to clean the spindle and clean out the bushings, being careful to keep oily fingers and belt from coming in contact with the spindle. After starting to grind, if spindle shows tendency to cloud up or stick, it may be necessary to have a little wad of paper to rub it with, keeping the spindle revolving, and traversing, to reach as much of the surface as possible. The spindles, however, which will run absolutely dry, are rare, almost as rare as the men who understand making and using them. Most of the spindles which are made to sell are fitted slightly free, and require the least bit of lubricating.

The best thing for this purpose is a piece of clean waste wadded up tight to about the size of a walnut. Put a couple of drops of watch oil on this and apply while the spindle is revolving, traversing back and forth several times to thoroughly clean it. If the spindle appears to gum or cloud up don't be afraid to keep at it, and after a few cleanings it will settle down to business and give no further trouble.

When a spindle becomes worn, so it shows the least particle of shake, it should be relapped to straighten it, using a cast-iron lap of generous length and washed flour of emery, the finer the better for the final finish, when all loose emery should be washed from the lap. Then after removing the old bushings the casting may be lapped slightly, to correct any change which may have taken place.

Make new bushings of good tool steel, harden, grind and lap the hole to a good, tight fit on the spindle, which may be used as an arbor to finish the outside of the bushings on. Leave the bushings a tight fit for the casting, and after pressing into place lap with a good straight close fitting cast-iron lap, long enough to reach clear through both bushings. After the spindle will enter, the spindle and bushings may be lapped together by using "XXX" washed flour of emery very sparingly, frequently cleaning and testing at high speed to determine when the right freedom is gained.

These spindles will stand remarkably high speeds and form when used clean, an air bearing. When a belt lets go while running at high speed the spindle will frequently run for two or three minutes, but at the same time when standing still it will be difficult to slide it in its bearings, so close is the contact.

Athol, Mass. W. H. SAWTELL.

## Accurate Circular Dividing in the Lathe

For accurate spacing of holes on the circumference of work, I have never tried anything to beat the following little scheme, for though it is rather slow, it gives very close results when properly applied, and needs no special rig.

The principle is best illustrated by a practical example, the piece shown in Fig. 1 being a dividing disk for a special machine which has to be bushed, as shown, with 8 hardened and ground bushings equally spaced. The spacing is required to be accurate to 15 seconds, which on this diameter allows us an aggregate or individual permissible error of about 0.0006 inch in spacing. The piece rigged up for boring is shown in Fig. 2, while the only special parts required are shown at *D* and *E*.

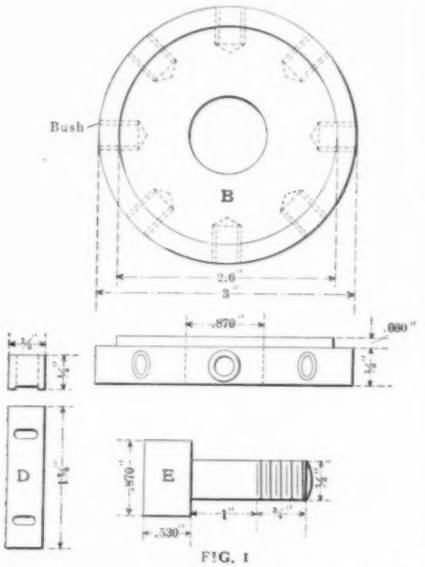



FIG. 1

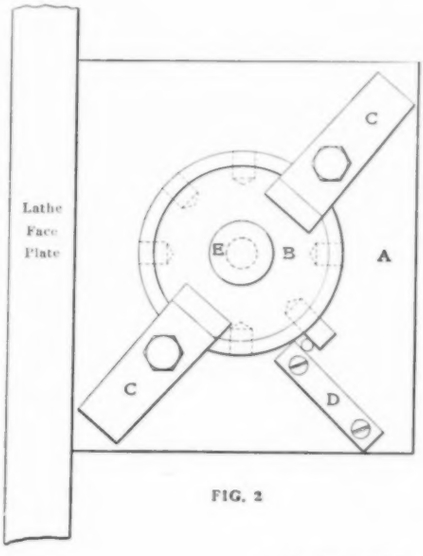



FIG. 2

American Machinist, N.Y.

ACCURATE CIRCULAR DIVIDING IN THE LATHE

*A*, Fig. 2, is an ordinary angle plate, scraped true and bolted to the lathe faceplate. It has a hole through it to carry the hardened stud *E*, which is ground to a snug fit in the piece and squared under the shoulder to rest squarely on the angle plate. The stud is secured by a nut and washer at the under side of angle plate. *D* is a gaging strip, ground and capped dead smooth and square, and provided with slots as shown, to allow a limited amount of movement to position it correctly before being clamped by screws to the angle plate as shown. *C C* are ordinary strap clamps to secure the work after positioning.

### Method of Locating

The position of two holes is laid out as accurately as possible by revolving the disk in the milling machine and scribing, and the centers are carefully center punched. A center line is scribed along the top face to allow it to be squared up with the lathe centers so that the holes shall point to the center.

The piece is then put on the stud, which has been previously clamped in position, the center line squared up with the lathe faceplate and the work firmly clamped. The angle plate is now moved about on the faceplate until one of the center-punch marks runs true with the lathe center, then the angle plate is also firmly clamped and the first hole carefully bored and sized with a 0.3-inch reamer, just enough being taken out by the reamer to smooth and size the hole.

### Boring the Holes

A close-fitting ground and lapped plug projecting about ¼ inch is now inserted in the hole, the clamps loosened and the piece revolved until center-punch mark No. 2 runs true with the lathe as tested by an indicator. The clamps are again firmly tightened, and the gaging strip *D* adjusted and clamped so that it is parallel with the projecting plug and just holds a lapped plug of known diameter between its gaging face and the surface of the plug in hole No. 1. Hole No. 2 is now bored the same as No. 1, the plug removed from No. 1 and inserted in No. 2, and the piece again revolved until the plug, now in hole No. 2 makes contact with the gaging plug and strip *D*. Hole No. 3 is now bored and the same order of routine followed on subsequent holes until the hole first bored comes around into line with the lathe center, having made a complete circuit. Now the amount this plug runs out of truth as measured by an accurate indicator riding on the plug close up to the body of the disk gives the accumulation of error of all the individual divisions. Thus, if it throws 0.016, we know that each individual pitch is 0.001 inch long or short as the case may be, and needs to be corrected.

This will necessitate going over the holes again, so we rebore and ream the hole without shifting its position to 0.350 inch, insert a plug of this size and substitute a gaging plug 0.025 inch smaller than used on the previous combination, or minus as the case may be, the necessary 0.001, to correct the pitch, and go over all the holes again with the fresh combination, and if the last hole shows no more fluctuation of the indicator than double the permissible variation (0.0012 inch) the job is correct and finished.

It goes without saying that this method needs a bit of skill and care, but with these exercised, the results are excellent. This principle of finding accumulated error and correcting therefrom has a much wider application than merely to the class of work described in this article.

George C. Gay.

Salford, Manchester, England.

## A Multiple Drafting Table

When there are several sheets to be handled on a drafting job, as in making detail drawings from an assembly view, or when redesigning or changing drawings of a machine, or when making a drawing similar to one already made, it is often necessary to handle and refer to a number of drawings, or sometimes, on account of the size or complexity of a machine, to work two or more partial assembly sheets simultaneously while designing. One method, when space and equipment allow, is for the designing draftsman to spread himself over as many tables as he requires, a drawing tacked to each; another is to put all sheets, one on top of the other, on the table, nailing them down with lath at the back margin, and hanging the top ones as they are completed over the edge like the leaves of a book. Still other methods are to tack the sheeets not in present use on the wall, or to pin them to the window shade for ready reference.

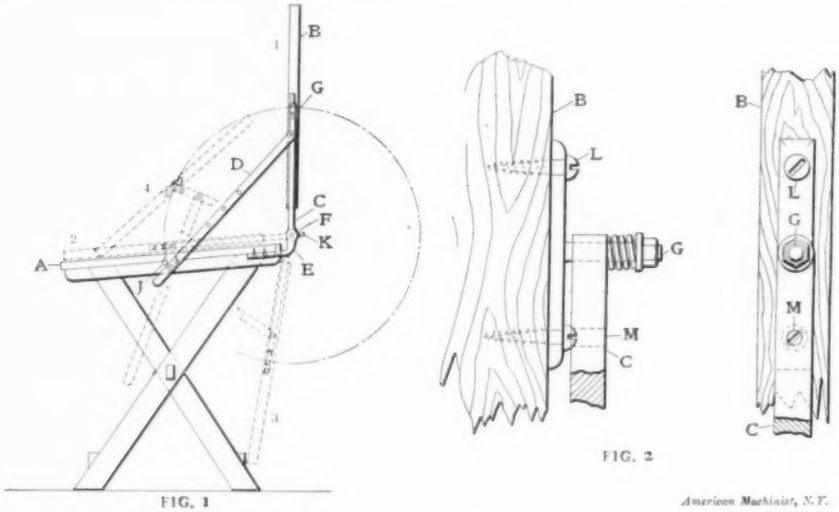



FIG. 1 FIG. 2

A MULTIPLE DRAFTING TABLE

The drawing-table attachment shown herewith does away with all makeshifts, is convenient, cheap, neat, takes but little space, always keeps the drawings right side up, permits the working up of three sheets at a time, and facilitates ready reference from one to the other without the draftsman leaving his position; the drawings are tacked down securely all the time. It also permits, on one-sheet work, of a draftsman changing from one job to another without changing the drawings on the board, a great convenience, as in changing on account of a rush job, or starting on another job before receiving comments or approval on the one finished.

Two brackets *E*, Fig. 1, are fastened to the under side of the table in which turns a piece of 5/8-inch cold-rolled shaft *F*. The arms *C* are made of 5/8-inch square machinery steel, and are keyed to the shaft with set screws *K*, the right-hand one being adjustable along *F* to suit different widths of swinging boards shown at *B*, which may be quickly interchanged by removing the nuts at the pivot *G*. The swinging board *B* has a working face on either side and is held by the indexing of the round-head screws *L* in the holes *M* in the arms *C*, Fig. 2, in the vertical position shown by the full lines in position 1. Thus, when the draftsman is working on the top of the table *A* the drawing on *B* is always in front of him for reference and scaling, and he may readily see the drawing on the opposite side by pivoting *B* about to the reverse position.

The brace *D* is of 1x1/4-inch steel, and is only attached to the left-hand arm *C*, and serves as a handle to bring the board forward or back, and as a brace to adjust and to hold it in the required position by means of the holes which slip over the stud in the bracket *J*. An annular groove 1/32 inch deep and 17/64 inch wide in the stud prevents *D* from slipping off accidentally.

By releasing the brace *D* altogether from *J*, board *B* will lie flat on the table *A*, as indicated by dash lines in position 2, protecting the drawing underneath and permitting the draftsman to work directly on the drawing on *B*, the board being enough thicker than the arm *C* to permit of the use of the T-square when either side is up. It is entirely free from the objection of slipping around and spoiling the underneath drawing, as is the case when laying an additional board on the top of a drawing already on the table. It can be thus closed down at night and covered over and when the board *B* is not in use it may be swung around, back and under the table, as indicated by the dash lines in position 3. Another use that some of our draftsmen have found for it, but for which it was not originally intended, is to tilt it to the proper position with a sheet of plain drawing paper tacked on *B*, to act as a reflector and throw an extra diffused light on the drawing on *A*.

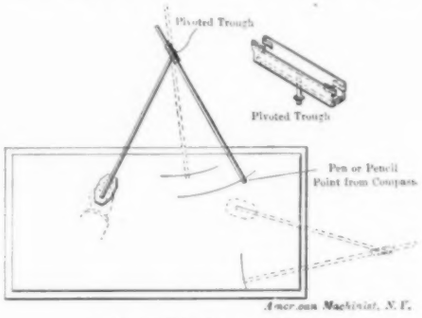
Position 4, dash lines, shows a very convenient position for observation and discussion, and when making small detail sheets from an assembly requiring only the lower half of the table *A*, board *B* can be swung forward in a vertical position, not indicated, one-third the distance from the back edge of *A* and still clear *A* enough to allow *B* to be reversed.

My experience is that it proves a most useful and time-saving device, and that when once familiar with it a draftsman would think about as soon of doing without it as he would of climbing 20 flights of stairs when there was an elevator handy.

Camden, N. J. L. E. DUDLEY.

## A Modified Beam Compass

All who have occasion to work over a drawing board know how clumsy and unwieldy an instrument a beam compass is. In almost every instance where it is used the center falls off the board so that various expedients, such as having a board held by another, or a support of books on top of a stool, are adopted. The accompanying illustration shows a device resulting from an attempt to avoid these annoyances.




A MODIFIED BEAM COMPASS

As seen, the pen or pencil point taken from an ordinary compass set is secured in the end of a wooden bar resting in a sheet-metal trough pivoted to another bar, but free to move endwise in the trough with slight pressure. In any position the trough and its pivot act as a center about which the pen or pencil point moves and the radius can be readily varied. The left hand controls the position of the pivot, and its location for any center can be noted on the paper for future reference on the part of designer or tracer, or it can be found by trial much easier than with ordinary beam compass.

It will be noted that this device does away with the necessity of a beam-compass set costing several dollars and rarely used. As made and described it is crude, but serves the purpose and no doubt others can suggest improvements in details. For one thing a scale could be added to the radius bar with its zero over the pencil, and a pointer carried opposite the center of the pivot enabling one to read the radius on the scale at once.

Portland, Ore. FRANKLIN SWEET.

# Discussion of the Previous Question

## Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

## WE PAY FOR THESE ALSO

### Machine vs. Hand-work in Steel Punches

With reference to the article on page 711, Volume 32, Part 1, I am very much surprised at the opinion expressed by Mr. Noyes that steel letter cutting by machinery is an impossibility, for twelve years ago I was cutting steel punches on a machine made by the Benton Waldo Company, Philadelphia.

A few years ago this was the machine generally used and the rate of cutting about 12 a day. The firm of which I am an employee has produced a machine which is all but automatic and which is worked by girls turning out an average of 8 per hour. These are *perfect* punches, being used for punching matrices for type production, every corner and crotch being sharp and clear, hair lines, serifs, body lines, face and position all accurate to 0.0001 inch to measurements from the original design, the depth from face to shoulder being from 0.05 to 0.075 and the face size varying from 0.05 to 0.25. They are cut in cast steel and have been cut in Novo Superior also, by cutters made of 0.055 Stubs steel wire with a cutting surface of from 0.025 to 0.0005.

Of course this work is far superior to that mentioned by your correspondent, but if it is possible to do this good work by machines, surely it is not impossible to cut that class of stamp to which Mr. Noyes refers.

THOMAS H. KIMBER.

Surrey, England.

### Fixtures for Boring Radial Drilling Machine Arms

At page 460, Volume 32, Part 1, J. T. Samuels gave a description with sketches of a planing fixture, for accurately locating the arm of a sensitive radial-drilling machine, while being planed, so as to insure the arm being dead square with the column or upright. The method described, of planing the arm after it has been bored, is in my opinion open to criticism, and we find we can get better results by planing the arm first, and then locating the hole to be bored from the part already planed.

Fig. 1 shows the side and end elevation of our type of arm, which is somewhat different to that shown at page 460. The guides, *A*, *B* and *C* are planed at the first operation, the casting being set approximately straight on the planer table for this operation, and clamped down on packing pieces in the usual way; the planed arm is then secured in the fixture shown in Fig. 2 and also in Fig. 3, which shows the arm secured in position in the fixture. Referring to Fig. 3, the fixture is a hollow casting, planed on the angular side *D* to suit the arm also on the bottom *E* and *F*; *I* is a shallow depression, cored in to save machining, *G* is a planed steel strip, and *H* the four clamping screws, which bear against *F* and force it up against the column slide when in position, which in turn is forced tight up against the solid side *D* in Fig. 2; the casting is accurately planed on the bottom, *J* is a shallow recess cored in, and *K K* are two tongues, which are accurately machined to fit in the slots planed in the table of the boring machines which the fixture is used on. These tongues must be exactly parallel with the angular edge *D*, as upon this the accuracy of the product turned out depends. Four slots *L* are cored in for the holding bolts.

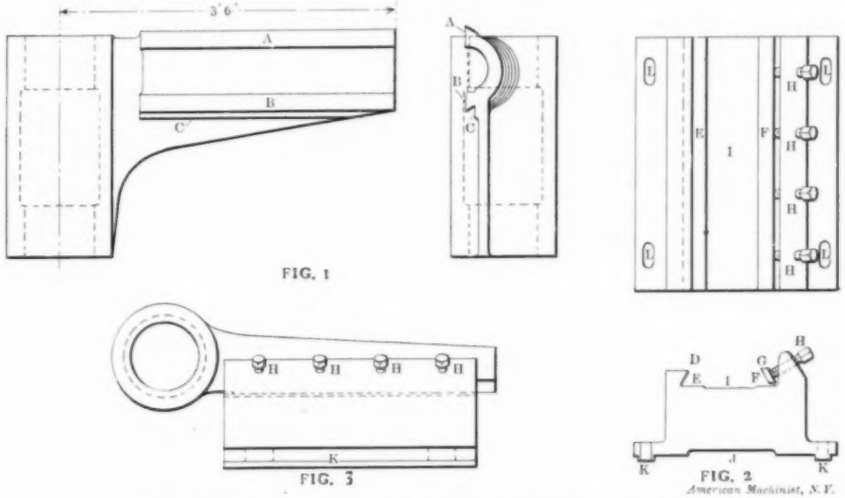



FIG. 1

FIG. 3

FIG. 2

American Machinist, N.Y.

FIXTURE FOR BORING RADIAL DRILLING MACHINE ARM

This fixture is cheaper to make than the one shown at page 460, and in addition there are no loose or moving slides, which in time get worn, and are bound to have an effect on the accuracy of the work turned out.

Birmingham, Eng. J. CROSBY.

### Premium Limits for a Varying Number of Machines

In reply to the query on page 31, as to the methods of setting premium limits on work on which a workman operates a varying number of machines, this will vary somewhat with conditions, but, in general, the proper way is to set a premium limit for the machine—not for the man. If a machine, as an automatic screw machine, has a maximum capacity of, say, 10,000 pieces per day, and the average daily output under proper supervision is, say, 6000 pieces, set the limit at 7000 pieces per day (or better at 1.43 hours per 1000 pieces, written on record cards, etc., as $\frac{1.43}{M}$) and pay the workman whatever premium he makes on the machine. If he runs only one machine, this premium will be rather small. If he runs two machines, with limits set on each, he will get whatever premium he can make out of the two; this will very rarely be twice, or anywhere near twice, what he will make on one machine, as there is almost certain to be more lost time on each machine than when running only one machine.

The same ruling and arguments hold good on three or more machines. The man's responsibility is greater, as is also his labor and activity, in proportion to the number of machines he operates; his day wages are a constant factor, so the only extra compensation he gets for this added work and responsibility is the extra premium paid him. If, in running two or more machines simultaneously, he gets the maximum capacity of each, he is a good man and will earn all he gets, for he is the cheapest man that can be put on the job.

In setting limits on this work, consid-

eration must be taken of the general conditions of the department; that is, if, in general, the workman will operate two, three or more machines more frequently than he will be operating only one, the limits may be set a little closer than if he is to operate only one or two machines most of the time, and more only as an exception.

For some shop conditions, where an operator handles a group of machines (generally similar) but the number of them in actual operation varies from day to day or hour to hour, it is often expedient to set a certain limit on a given operation when operator is running only one machine of the group, a smaller limit when he is operating two machines, and a still smaller one when operating three machines. In this case the operator, as well as the foreman or timekeeper, should have before him, or easily accessible, a schedule of the various limits so there will be no confusion about them. Using this method of figuring, the man, rather than the machine, is taken as the basis of calculation. This, however, is not generally as satisfactory an arrangement as the former method.

Sometimes on certain machine tools where the cuts are long, or the machines are partially automatic, so that the workman can at times run two or more machines, it is advisable to pay workmen a fixed day rate, with premium limits, for one machine, and give him an additional rate of, say, five cents an hour for each additional machine. Premium limits may also be established for these additional machines in accordance with their capacity when working under these conditions.

Tipton, Ind. T. A. Sperry.

## Twist Drills and Their Shanks

The article by F. A. Halsey, on page 26, relating to twist-drill shanks, prompts me to make a few remarks about those abused shanks.

When I served my apprenticeship it was in a shop which had just been built with new equipment throughout, as the old plant had been destroyed by fire. During my time there I used to wonder why technical papers referred so often to broken tangs on twist drills, as I had never seen one. I left there and was away for a number of years, working on the erecting floors of large shops where I never saw a twist drill, and on my return I was very much surprised to see many twisted-off shanks. On looking for the cause I found the sockets cut and worn out, due to the fact that the drills had been used in the lathes with drivers (dogs) which were often put on with the set screws bearing on the shanks, so marring them that they would not fit the sockets. As long as the sockets and drills were in good shape there was no trouble from twisted shanks.

Another thing I have noticed is that only those drills which are larger than the big ends of their shanks suffer in this way, such sizes as 17/32, 9/16, 13/16, 7/8, 1 1/8 to 1 1/4 inches, etc.

My opinion is that Morse, or whoever made the first taper-shank drills, made them for his own use; that he had a drill with a spindle bored 9/16 inch, which he rebored taper and kept on increasing the size of drills which he used in this machine until he was using a 7/8-inch drill, and those original sizes which were adopted from the standpoint of convenience have been adhered to ever since.

The obvious way to correct these shanks is to make drills above 1/2 inch to fit the next larger socket. Those above 3/4 inch should also have their shanks increased, as well as those above 1 1/16 inches, so that except in the case of the larger-size drills, no shank shall be smaller at the big end than the drill which it belongs to.

Another way in which these failures might be prevented is to shorten the shank, cutting off the small end and so giving a larger tang, but this involves new sockets and also new drill spindles, so that it is not very feasible.

The first remedy offered would involve no change except to the makers of twist drills, and I do not think it would be much of a change for them.

This would make the drills fit in following sockets: 1/4 to 2-inch in No. 1, 33/64 to 3/4-inch in No. 2, 49/64 to 1 1/16-inch in No. 3. I have not the slightest hope that this change will be made, but it seems the most rational way to correct an error.

Ottawa, Canada. J. Stevenson.

It has often surprised me to notice that you do not seem to have any system of referring to articles previously published in your paper. Taking, as an example, Mr. Halsey's article, Twist Drills and Their Tangs, published on page 26, an improvement of the method described was shown in the American Machinist on page 296, Part 1, 1908. The essential difference between the two methods lies in the key used.

While the method described by Mr. Halsey shows a key of a rectangular section, the improved method, which was first introduced by Carl G. Barth five years ago, has a "Barth key," which is made from a rectangular section with one-half of both sides beveled off at 45 degrees. The superiority of this key generally was pointed out by me in the American Machinist, page 769, Part 2, 1907.

The particular advantages of this key in the taper sockets of drill presses, milling machines and boring mills are the following:

1. The shank enters more easily into its sockets.

2. There is no tendency to shear the key nor to turn it around in its position, the only strain on the key being compression.

3. Reducing sockets (or sleeves) can be made much thinner with this key than with the style used by Sellers & Co., this latter key being very deep-seated. Especially is this a distinct advantage when standardizing a shop in which through a number of years a variety of machine tools of different styles and makes has accumulated.

Everything considered, the difference in cost in introducing one method or the other is slight.

Bayonne, N. J. Frederick Oyen.

## Critical Points in Carbon Steel

On page 938, Volume 32, Part 1, Frank George discusses, at the request of W. Osborne in some previous issue, the critical points in carbon steels, in a very interesting manner. I agree with him that to get the best results in hardening steel it is necessary to heat practically about 20 degrees or a little above the calescence or transition (as Mr. George has it) point.

Mr. George seems to have used an ordinary pyrometer in his work, and, while admitting that for ordinary steel this is accurate enough, I think for special work a method of greater accuracy should be used to find the critical points; for it seems futile to talk of 1357 and 1346 degrees. These might very easily really be 1360 and 1350 degrees, and nobody would be any the wiser, when using an ordinary thermo-couple pyrometer, for none of these instruments are accurate at high temperatures. When great accuracy is required, some system, such as the "Lindeck," is necessary in locating the critical points.

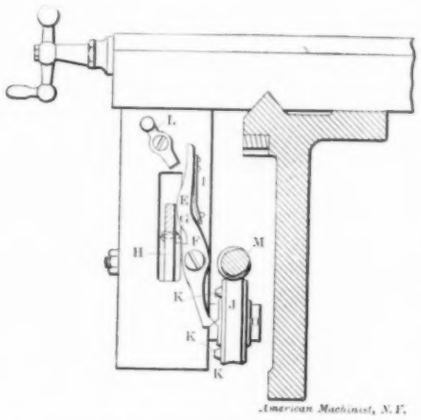
A point well marked down by Mr. George, is that of heating slowly at first to a dull red, and afterward heating quickly to the required temperature. There is more work spoiled by rapid heating at first than many engineers are aware of. The necessity for slow heating at first is very well known to furnacemen dealing with large masses of steel, for the reason that the outer skin will readily tear away from the inner core if care is not taken.

So long as steel is taken above the calescence point it may be quenched with equally good results anywhere between that point and the recalescence point; but, especially in high-carbon steels, it is not wise to allow for any fall in temperature after removal from the furnace. The heat passes so rapidly to the air, and the range between the critical temperatures is so small, that work is easily ruined and errors creep in. I have found a salt bath a most useful and accurate apparatus in which to do the heating of special work.

Sheffield, Eng. M. Cowan.

## Helps in Cutting Threads

The problem of correctly reëngaging with the lead screw when screw cutting is one which has several times engaged my attention. Thinking over this question I set about devising something which would positively prevent the engagement of the nut and screw except at the right time. I had then never seen the idea of using a worm wheel carried on the carriage, but starting with the idea of effecting engagement with the screw at every inch of traverse, I hit on the arrangement shown. This consists of a locking lever *E* pivoted to the lathe saddle, and having a lip or catch *F* arranged to engage with the corresponding catch *G*, on hand lever *H*, which operates the split nut on the lead screw *M*. The spring *I* tends always to keep lever *E* in engagement with *G*, thus preventing lever *H* from closing the nut on the screw. *J* is a worm wheel carried on a pin on the saddle and gearing with the lead screw *M*. It has 54 teeth, and




TO PREVENT THROWING IN THE HALF NUT AT THE WRONG TIME

on one side project the V-shaped cam pieces *K*.

There are six of these cam pieces, one for every nine teeth of the worm wheel, and they are arranged to engage with the projecting lower end of lever *E*, as shown, when the worm wheel revolves, thus at intervals releasing lever *H*. *L* is a pawl which holds *E* clear of *H* when desired. Lever *E* is so shaped that when *H* is raised to its highest position it holds *E* back with its lower end clear of cams *K*.

When the nut is closed and the carriage is traversing, the wheel *J* does not revolve but remains with one cam engaged with lever *E*. It follows that it is not necessary to start every cut at the same position on the lathe, but correct engagement can be had at any point by simply pressing on lever *H*. As soon as one of the cams presses back lever *E*, handle *H* is released, and drops, engaging the nut. This is an advantage when cutting a screw of any length, as often it is necessary to take a little more off certain parts after the other parts are down to size.

It is also a help to the operator to be able to concentrate his attention on the cutting tool without having to take trouble over picking up the cut, and a considerable saving of time is effected. Even when a lathe has reversing motion it is far from being so satisfactory to use as one fitted with this controller. The operator has to handle the reversing lever twice every cut and stop while he feeds the tool in, besides losing time as the saddle slowly returns to the starting point. All the cams, etc., in this attachment are hardened, and although the first one made has been in pretty constant use for several years it always works satisfactorily and requires practically no attention. This device is patented in Great Britain.

Leyton, England. B. LAWRENCE.

## Using Compounds to Harden Steel

I add to my list of compounds for the treatment of high-speed steels, the one given by Mr. Weaner on page 919, Part 1, Vol. 32. It has a new ingredient, at least to me, that can be used in the compounding of compounds for the treatment of high-speed steel. The ingredient referred to is the pulverized seed of a secale cereal. I wonder what chemical action takes place in the using of this product? It would surely be interesting to know how the molecules of the steel act under the application of a secale cereal meal. It will evidently open up a new market for this product and cause the baker to advance the price of rye bread so the burden will again fall on the poor.

Have we made any material progress when we consider these facts as well as a few others which naturally arise? The most prominent one is the fact that we can buy a steel for less than one-third the price of high-speed steel and by not using any compounds, but just giving it the proper treatment it will be far superior to any high-speed tool not brought to the proper heat in the hardening, no matter how many compounds the steel is treated with. As long as we are willing to look for and use compounds in the treatment of steel, just so long will we miss the best results possible to be obtained.

It is surely time for our mechanics to leave the idea of mysteries connected with the treatment of steel and give it a fair chance to do its best by giving it fair treatment. In order to give it fair treatment it will be necessary to have at least one furnace where high-speed steel can be heated until it becomes almost mushy without pitting or blistering.

To me there are but two ways of heating finished tools made of high-speed steel. One is a gas furnace so constructed that the force of the air is completely checked before it reaches the work. The other is the heating in fused electrodes. The latter process is not in use in any place outside of Germany, and as to just what the process will do when applied, I do not know, so this would leave us but one fire for heating high-speed steel and this is the gas fire.

We can and do harden high-speed steel in a forge fire but why should our machinists and toolmakers try to harden a finished tool in a fire where the best in the steel cannot be brought out without blistering and pitting the tool?

If a tool cannot be hardened so it will do its best, then why use an expensive steel to make the tool? Let me give a few tests to put his hardened high-speed steel to. After heating the steel as hard as it is possible to without blistering or pitting, cool the tool in fish oil. When the tool has cooled so it can be handled with the hands, place it in the furnace and heat slowly until it reaches a red at least visible in daylight, then let it cool in the air. If this tool can be filed when cold, it has not been brought to the proper heat for the hardening. It must have a higher heat..

There are several peculiar things about high-speed steel. One of them is when the steel has not had the highest and best heat, it will break very easily and is very hard, but when it has received the proper heat it can be easily dented or peened with the hammer. Or better still, it will bend and take a set before breaking. This is a quality that we should strive for.

Do not look for a compound that will do this. To do so will be a waste of time and money. Do not disgrace our steels by trying to dope them with anything but heat treatment. It is true that we can prepare a solution that will enable us to harden and prevent the letting down or tempering of carbon steel but we will not have all there is in the steel when it is treated in this way. Consequently it is better to harden and temper than to use any compound.

I want to call attention to tests of high-speed steel that have possibly come under your observation. That is, where the tool has become red hot in use and still continues to do work. If this tool had not been brought to a high heat in the hardening, it would not stand such use. Any tool can be brought to this heat if the proper furnace and fuel are used.

If your shop cannot afford to spend $15 for a furnace that this work can be done in, do not lower our enlightened age by using compounds on an expensive steel when a much cheaper steel will do better work if properly treated.

Davenport, Iowa. C. U. SCOTT.

---

The production of pig iron in the United States for the half-year ended June 30, 1909, was 11,022,346 long tons. This is an increase of 4,104,342 tons, or 59.3 per cent., over the first half of 1908.

# AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

*CIRCULATION STATEMENT*

*During* 1908 *we printed and circulated* 1,205,750 *copies of the* AMERICAN MACHINIST. *Our circulation for July,* 1909, *was (weekly, monthly and European)* 110,000.

*August* 5..... 35,750

*This paper reaches* 35,750 *separate readers each month and* 19,750 *each week.*

*None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.*


## Contents


PAGE

Inventing and Patenting—A Will o' the Wisp ..... 221
Diagram for Crank Shaft and Tool Positions on Double Acting Press..... 224
Operations in Building and Inspecting Lathes ..... 225
Still Another Artsmith..... 231
Welding Metals with Electricity..... 233
A Simple Backing Off Device..... 241
Standard Machining Elements and Machine Rental Plan..... 242
Are We Neglecting Vertical Planing Machines? ..... 243
The Greatest Bakery in the World..... 244
Sectional Blanking Tools for Electrical Work ..... 247
Practical Letters from Our Readers:
Some Points Regarding the Traverse Spindle Grinder....Accurate Circular Dividing in the Lathe....A Multiple Drafting Table....A Modified Beam Compass.....248-250
Discussion of the Previous Question:
Machine versus Hand Work in Steel Punches.... Fixtures for Boring Radial Drilling Machine Arms.... Premium Limits for a Varying Number of Machines....Twist Drills and Their Shanks....Critical Points in Carbon Steel....Helps in Cutting Threads.... Using Compounds to Harden Steel.....251-253
The Cleveland Technical High School... 254
The Song of the Dying Swan..... 254
New Tools and Machine Shop Appliances 256


## The Cleveland Technical High School

Various announcements of the Technical High School at Cleveland, Ohio, have been made and we are now in receipt of a circular relating to it, from which a fairly definite idea of its scope and purpose may be obtained.

A very superior building has been provided which, along with class and lecture rooms, is also fitted with various shops and laboratories, the shops for the boys comprising a pottery department, a blacksmith shop, a machine shop, a foundry and a wood-working shop.

There is no indication that the teaching of trades is contemplated, the catalog saying for example: "The shop work of these [the first] two years is therefore practically a general course in manual training. This work is intended to be educative and creative as well as technically instructive. After completing his two preliminary years in wood and iron working and in mechanical drawing, the student may then devote a major part of his last two years to the particular branch along which his abilities lie. In this selection of his vocation and helping a boy to 'find himself' the school can exercise an important function."

That the school is not to be a trade school, in the proper sense of that term, is further shown by the course of study for boys, in which the amount of time devoted to shop work and its distribution and division among various classes of work is such as to make the effective teaching of any particular trade impossible. This course of study for boys—there being a parallel course for girls—is as follows:

FIRST YEAR.

| | Periods per Week. |
|---|---|
| English | 5 |
| Arithmetic and algebra | 5 |
| Industrial geography | 5 |
| Mechanical drawing | 5 |
| Turning and cabinet making | 10 |
| Physical training | 2 |
| Study | 8 |

SECOND YEAR.

| | |
|---|---|
| English | 5 |
| Plane geometry | 5 |
| Elementary chemistry | 5 |
| Mechanical drawing | 5 |
| Pattern making and foundry practice, ½ year | |
| Forging, ½ year | 10 |
| Physical training | 2 |
| Study | 8 |

THIRD YEAR.

| | |
|---|---|
| English | 5 |
| German or industrial history | 5 |
| Physics | 5 |
| Mechanical drawing | 5 |
| Machine shop, ½ year | |
| Elective, any shop, ½ year | 10 |
| Study | 10 |

FOURTH YEAR

| | |
|---|---|
| Advanced mathematics or advanced science | 5 |
| American history and civics | 5 |
| German, elective academic or technical | 5 |
| Elective drawing or shop | 15 |
| Study | 10 |

In the fourth year 20 periods a week may be devoted to any line of technical training.

In comparison with the existing line of study in the public schools, the above is certainly a most promising departure. It at least shows, and in a very tangible manner, the recognition by educators of the fact that the public schools must be better co-ordinated with the industrial spirit of the times, but beyond this we fail to see that it has any considerable leaning toward the great system of trade schools that is now so much in the public eye.

Our readers are well aware of our limited faith in trade schools supported at public expense. It is our belief that this Cleveland example is a fair illustration of what may be expected of the public-school system in the development of its work on lines which have at least tangible connection with industrial pursuits. To the extent that it leans in this direction it has our heartiest sympathy and our best wishes for its success. The chief danger attending it lies in the confusion which prevails regarding the meaning of the term industrial education, and among the many, whose ideas upon the subject are hazy, we have no doubt that the Cleveland school will be triumphantly referred to as an example of a true trade school, which it is not. While it may do much in directing boys toward the industrial field as a means of livelihood, in inculcating the idea that this is a worthy field for their activities, and in giving them a mental bent in that direction, we doubt if it will accomplish much more. Nevertheless, even to this extent, and as an illustration of the awakening which is now in progress among educators, the opening of this school is an event of importance. We shall watch its progress with a large degree of interest.

## The Song of the Dying Swan

In this column last week we informed our readers of the collapse of the metric agitation at the annual convention of the American Society of Civil Engineers—the subject, it will be recalled, exciting so little interest that the formal report of a committee of the society in favor of the system fell absolutely flat and brought forth no discussion whatever, except a written communication that was not read.

Judge, then, of our surprise at receiving an account of the proceedings dished up in true prometric style to indicate a very different state of things and sent out to the daily press as a true account of the proceedings. This account, which is dated from Boston, reads as follows:

"At a stormy session the American Society of Civil Engineers, in convention in Bretton Woods, N. H., passed a strong resolution in which it was urged that all public and private schools should teach the metric system, which the engineers hope will be the standard and only system of weights and measures in the country.

"The report states in conclusion that a given time of five years should be allowed by the United States Government to have the system go into effect.

"It was stated in emphatic terms that at the present time the American people have no appreciation and understanding of the value of the system."

To those who have not critically followed the metric controversy this may look a little odd, but to those who are familiar with the wholesale manner in which so-called facts have been manufactured out of the whole cloth by the metric party, there is nothing strange about it.

Who is responsible we, of course, do not know, but we hazard little in saying that the origin of this metric gem is essentially the same as that of numerous other fictitious statements by which the metric case has been bolstered up. The thorough going metricite is so thoroughly convinced that whatever he would like to have true regarding the system must, therefore, be true that he presents it as true, and this seems to be the only possible origin of this statement, which will, no doubt, take its place in future prometric literature as a conclusive illustration of the overwhelming strength of the system among engineers.

The report printed in *Engineering News* was made by a member of the editorial staff of that paper who was present at the meeting.

## A Merchants' and Manufacturers' Exchange Building for New York City

The Merchants' and Manufacturers' Exchange, of 125 East Forty-third street, this city, through the coöperation of the New York Central & Hudson River railroad, and the New York, New Haven & Hartford railroad, is to erect two great exchange buildings adjoining the new Grand Central station, which is now in progress.

The buildings are to cover two entire blocks, bounded by Forty-sixth and Forty-eighth streets, Lexington avenue and Depew place, each plot being 200x275 feet in size, are to be 12 stories in hight, will cost approximately $6,500,000, and will contain 1,300,000 square feet, or approximately 30 acres of floor space, over one-half of which has already been spoken for.

In addition to salesrooms and offices, the three lower floors of one of the buildings will be devoted to an assembly hall for trade conventions, with suitable areas for the display of goods, machinery, etc., exhibited at such conventions. Other conveniences such as club rooms, a restaurant and roof garden are also to be provided.

The enterprise, to some extent, is patterned after the New York Furniture Exchange, which for 20 years has been the Eastern selling headquarters of more than 300 manufacturers, and which has demonstrated the advantage of the centralization of salesrooms of allied lines of industry.

## National Conservation Congress

The first national conservation congress of the United States will be held in the auditorium of the Alaska-Yukon-Pacific Exposition, Seattle, Wash., August 26, 27 and 28, 1909. Arrangements for the congress are being perfected by the Washington Conservation Association, an organization comprising several hundred prominent men of the State.

The conservation congress promises to be the largest and most representative gathering of active conservationists since the conference of governors at the White House, Washington, D. C., when former President Theodore Roosevelt launched the campaign for a more systematic and universal conservation of the natural resources of our country.

## New Publication

STEAM POWER PLANT PIPING SYSTEMS. By William L. Morris. 481 6x9-inch pages; 389 illustrations; indexed. McGraw-Hill Book Company, New York City. Price, $5 net.

This is the first book to reach our hands bearing the imprint of the new technical book publishing company, the organization of which we noticed a few weeks ago. There is probably no feature of a power house, or large industrial plant, which can head the list of "things that are usually wrong" as truly as the piping. It often seems as if all the factors possible had conspired to make a systemless jumble of big and little pipes, crowded together in dark, unhandy places, crossing and recrossing, running at many different levels and defying the grasping of an intelligent idea of what they are for, where they come from and go to and what they contain. And oh! the cussedness of the inevitable repairs on such lines! Mr. Morris has appreciated these things and has developed systems for the various kinds of piping about the plant which, if followed, should bring about a neat condition of the plant itself and a contented frame of mind to the engineer or master mechanic. The method advocated for contracting for pipe work is perhaps open to discussion. It is to lay out this piping in the most general way and require the contractor to supply detail drawings of precise locations and supports as part of his contract. A considerable experience on the part of the reviewer with piping contractors and their work would tend to show that, in general, such contractors cannot be trusted to work out details in a manner acceptable to the owner.

The book is divided into 31 chapters, of which the first nine chapter headings are: Origin of Improper Piping; Piping Diagrams; Piping Systems; Condensers and Heaters; Live Steam Drips; Blow-off and Exhaust Piping; Air and Oiling Systems; Oil and Water Purifying Systems; Piping Details. The various systems in these chapters are numbered consecutively up to 66. The remaining chapters treat of details of piping for water, steam, air, vacuum, sewer, etc. Each chapter is given a key letter, those letters running from A to V, inclusive. The various items under each letter are numbered. For example, Chapter XXV, Air Line Details, is subdivided as follows: P1, Main; P2, Branch for Blowing Out Electrical Apparatus; P3, Branch for Oiling Systems; P4, Branch for Fire Protection; P5, Branch for Signal Whistles. This arrangement could well be adopted as a key on piping drawings and diagrams. The illustrations were made from original copy, especially prepared for the purpose and are a most valuable feature as presenting typical piping arrangements. We take pleasure in recommending this book to anyone who has power-station or industrial-plant piping to design, install, or maintain.

## Personals*

Frederick C. Cutting has been appointed manager of the New York City department of the Lamson Consolidated Store Service Company.

Donald S. Brown, formerly with the Dayton Hydraulic Machinery Company, has recently joined the forces of the Westinghouse Electric and Manufacturing Company, with headquarters at the main works in Pittsburg.

Charles Ethan Davis, until recently superintendent of the automobile department of the American Locomotive Company, has associated himself with the Warner Gear Company, Muncie, Ind., where he will act as general manager.

Charles R. Crane, vice-president of the Crane Company, Chicago, Ill., has accepted the important post of minister to China tendered him by the President. The business interests of this country look upon Mr. Crane's appointment as a highly desirable one.

S. A. McFaddin, formerly with Wysong & Miles, Greensboro, N. C., machinery agents, has accepted a position with the Prentiss Tool and Supply Company, and will look after their interests in the Pennsylvania territory, with headquarters at Scranton, Penn.

Frederick W. Hollmann, for some time connected with the Maryland Steel Company, in the capacity of steam engineer, has recently entered the employ of the Carborundum Company, Niagara Falls, N. Y., where he will act as assistant mechanical engineer.

J. E. Johnson, Jr., formerly general manager of the Princess Furnace Company, and an occasional contributor to our columns, has recently accepted a position with the Republic Iron and Steel Company, Thomas, Ala., as general superintendent of the Thomas division.

*Items for this column are solicited.

# New Tools and Machine Shop Appliances

## Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

## THE LATEST INFORMATION

### Improvements in the Chicago "Duplex" Hand Miller

The Chicago Machine Tool Company, Chicago, Ill., has lately made some improvements in the No. 3 size of the Chicago "Duplex" hand miller. In the engraving, Fig. 1, is shown the No. 3 machine with the vertical attachment in place. This attachment particularly adapts the miller to tool-room purposes, as well as for brass workers and manufacturers of small parts. The table has a wide bearing on the saddle insuring rigidity, and a taper gib is provided for taking up any wear that may occur. The saddle is so proportioned as to minimize the overhang of the table, when feeding to extreme lengths. It is arranged to receive automatic feed at any time, should it not be required with the machine originally. The knee on which rests the saddle is of box construction, having no opening through the top, and also has a long bearing on the column for securing additional stiffness. A bracket, which carries the nut for the transverse feed screw, is fastened to the saddle, and extends into a slot cast in the side of the knee. This arrangement gives protection to the feed screw, and also prevents any chips or dirt from falling inside the knee. This machine has a crank feed for the table, as well as hand-lever feed and power feed. The hand lever can also be used for quick return of the table, after a cut has been taken. A hand lever for the vertical movement of the knee is furnished. This hand lever is fastened to a shaft carrying on the other end a pinion meshing with a rack secured to the column. Fig. 2 shows the No. 3 machine with overhanging arm in place. This is readily applied by removing the vertical spindle attachment, it being but a few minutes' work to make the change from one to the other. An arbor for the horizontal spindle is furnished, and has a No. 9 Brown & Sharpe taper shank.

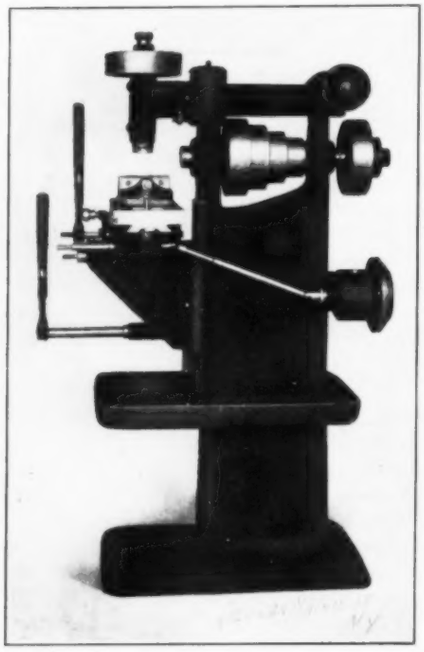


FIG. 1. CHICAGO "DUPLEX" HAND MILLER WITH VERTICAL ATTACHMENT IN PLACE

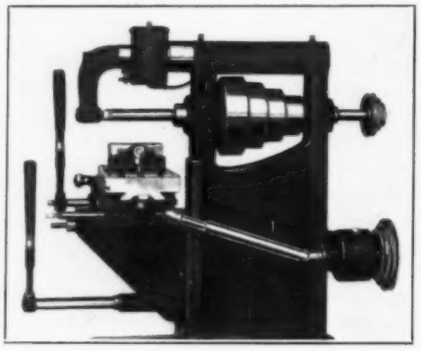


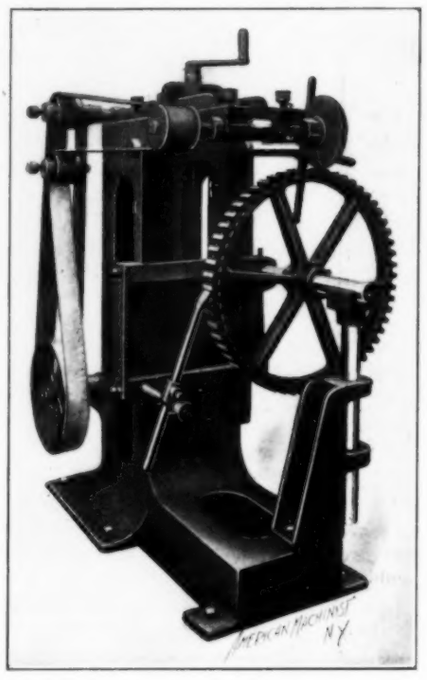
FIG. 2. CHICAGO "DUPLEX" HAND MILLER WITH OVERHANGING ARM

The vertical attachment is operated without gears. The spindle, which is bored for No. 9 Brown & Sharpe taper, runs in a split bronze bearing carried in a casing, which is split and provided with screws for taking up any wear that may occur in the bearing. In this casing is also a reservoir from which oil is supplied by a wick to the spindle bearings. End mills are held in place by a drawing-in collet, the collet being interchangeable in the vertical and horizontal spindles. The horizontal spindle runs in bronze bearings, which are fitted to taper seats in the column, and adjusting collars are provided for taking up wear. The spindle bearings, like those for the vertical spindle, are lubricated by wicking from oil reservoirs cored out in the column. These reservoirs furnish sufficient lubrication for about a year's running.

The power feed is taken from a cone pulley on the rear end of the spindle to a three-step cone pulley on the rear of the gear box. From the gear box the drive is through a universal joint shaft to a pair of 45-degree-angle spiral gears in the saddle. A worm is fastened on the shaft with one of the spiral gears, the pair of spiral gears and the worm being held in a rocker. This rocker throws the worm in and out of mesh with the rack in the table. The feed-gear mechanism consists essentially of a set of planetary gears through which the desired reduction of spindle speed is obtained to give the proper transmission of power to the table. The cone pulleys which transmit the power from the spindle to the feed-gear box are interchangeable, giving in all six changes of feed. The countershaft has self-oiling shaft bearings and the loose pulley is of single-piece construction.

### Gear Tooth Grinder

This machine has been designed for grinding the teeth of cast gears, both spur and bevel, as well as racks. The operation is very simple, the grinding head carrying a wheel of a shape to suit the gear teeth to be ground, and the whole grinding head being moved across the base of the wheel by the handles shown. This machine will handle spur gears up to 36 inches in diameter, and an attachment is supplied for holding bevel wheels at any desired angle while being ground. The



GEAR GRINDING MACHINE

indexing is accomplished by the wheel itself, a tooth rest at the back dropping into place as the wheel is turned into the next position. A machine of this kind should be found very useful in shops using cast gears in their work. It is built by the G. W. Baker Machine Company, Wilmington, Del.

## Westinghouse Direct-current Portable Ammeter

All authorities agree that meters working on the D'Arsonval principle, with a current-carrying coil moving in the field of a permanent magnet, are superior to any other type. Heretofore it has been impossible to obtain moderate-priced meters of this type, owing largely to the high cost of manufacturing the delicate moving elements.

The Westinghouse Type "R" meters

WESTINGHOUSE DIRECT CURRENT PORTABLE AMMETER, TYPE "R"

made by the Westinghouse Electric and Manufacturing Company, Pittsburg, Penn., are for direct-current measurements and can be supplied for any current or voltage. Some of the features embodied in these instruments are their excellent "dead beat" qualities, practically uniform scale, polarity indication, freedom from effects of temperature change, or external field, adaptability for use with shunts, and absence of residual errors. These are some of the advantages that follow from the use of the D'Arsonval type, which are not found in the "moving-iron" type. The single-airgap construction enables the moving coil to be moved without disturbing the magnetic structure or opening the magnetic circuits and thus permanently weakening the magnets. This facilitates the making of repairs by the meter user. The construction is especially suited for portable meters because the coil and pointer balance each other on the moving element. There is ample clearance between the magnet pole tips for the moving coil, while the reluctance of the single gap is not high. The ammeters are either self-contained with double range, or have separate shunts, the large sizes, of course, having external shunts. These shunts are interchangeable, and are made of a special alloy which has zero temperature coefficient and avoids all error due to the thermoelectric effect of difference in temperature between the alloy and copper terminal junctions. The meters are put up in walnut cases 6¼x6¼x4 inches, and weigh about 5 pounds.

## The Volcano Torch

The torch herewith illustrated burns gasolene, which is generated into gas before leaving the cylinder. It reaches the burners in a superheated gaseous state, and, therefore, there is a good combustion at the burners, with a high degree of heat. The main body or tank is a steel cylinder that will sustain a pressure of 2000 pounds per square inch. It can be safely operated at from 10 to 200 pounds, and will easily maintain a working pressure between 80 and 140 pounds without the use of an air pump.

The torch is useful for making or releasing shrinking fits of every description; for extracting broken taps and drills from work; for brazing all kinds of work; for straightening shafts or similar pieces by heating them between lathe centers; for annealing, hardening and tempering tools; for heating soldering coppers, and for numerous kinds of odd jobs or repair work.

The torch is made in several different sizes, and can be refilled without stopping work. It can be carried in one hand, and is instantly ready to use. In Fig. 1 the torch is shown as fitted up with a fire-back, that is lined with asbestos in such a way as to be quickly replaced with a new lining. The burner is fitted with an adjustable joint so that it can be swung to any angle desired, and this makes it very useful for heating tools to forge, harden, temper, or anneal them. Pieces 3 inches in diameter can be heated to a red heat in from 10 to 15 minutes, and the larger sizes are capable of heating shafts 5 to 6 inches in diameter in from 15 to 25 minutes.

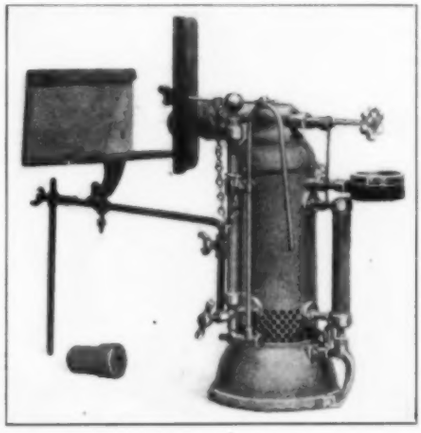


FIG. 1. TORCH FITTED WITH FIRE-BACK

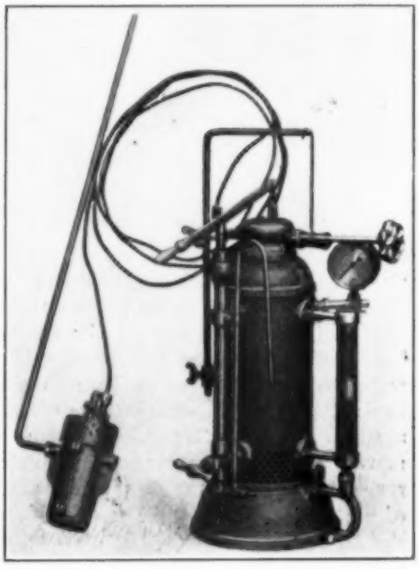


FIG. 2. TORCH FITTED WITH EXTENSION BURNER

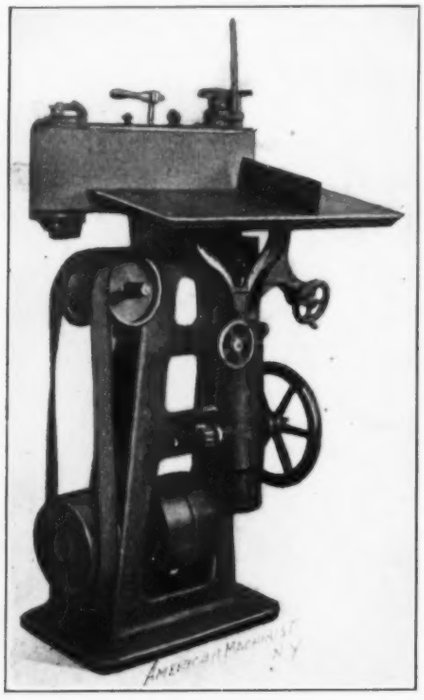
The torch as fitted with an extension burner is shown in Fig. 2. It is provided with a generator that will generate any gas condensed into liquid form, while passing through the flexible tube, and it therefore gives an intense heat at any distance from the machine.

These torches can also be used for illuminating by changing the burner plug. They are fitted up with a regular kerosene oil lamp, if desired, in place of the auxiliary burner, and this can be used in

places that are protected from strong currents of air. They are manufactured by the Volcano Torch and Manufacturing Company, Erie, Penn.

## Patternmakers' Sanding Machine

The proper jointing of patterns is an important part of a patternmaker's work and the machine shown has been designed to assist in making joints of all kinds



PATTERNMAKERS' SANDING MACHINE

accurately and rapidly. A sanded belt replaces knives, the work being held against this at any desired angle by the tilting table in front and its guide. The sanding belt is 6 inches wide, and runs over a metal backing plate which keeps it perfectly flat while the work is being pressed against it. This belt is automatically moved up and down through a limited range by a very ingenious arrangement of the idler pulley at the left. This is shifted into an inclined position, first one way and then the other, so that the sanding belt is continually traveling up and down, which distributes the wear and insures better work.

The table has an extension that goes around the leading roll, which is very useful for inside circular work. It can finish core boxes to a knife line, with a great saving of time, draw prints, and, in fact, round and square prints can be cut to shape with even draft on all sides. For small core boxes or inside of small circles, there is a spindle on top of the leading roll on which may be turned a special roll for any purpose.

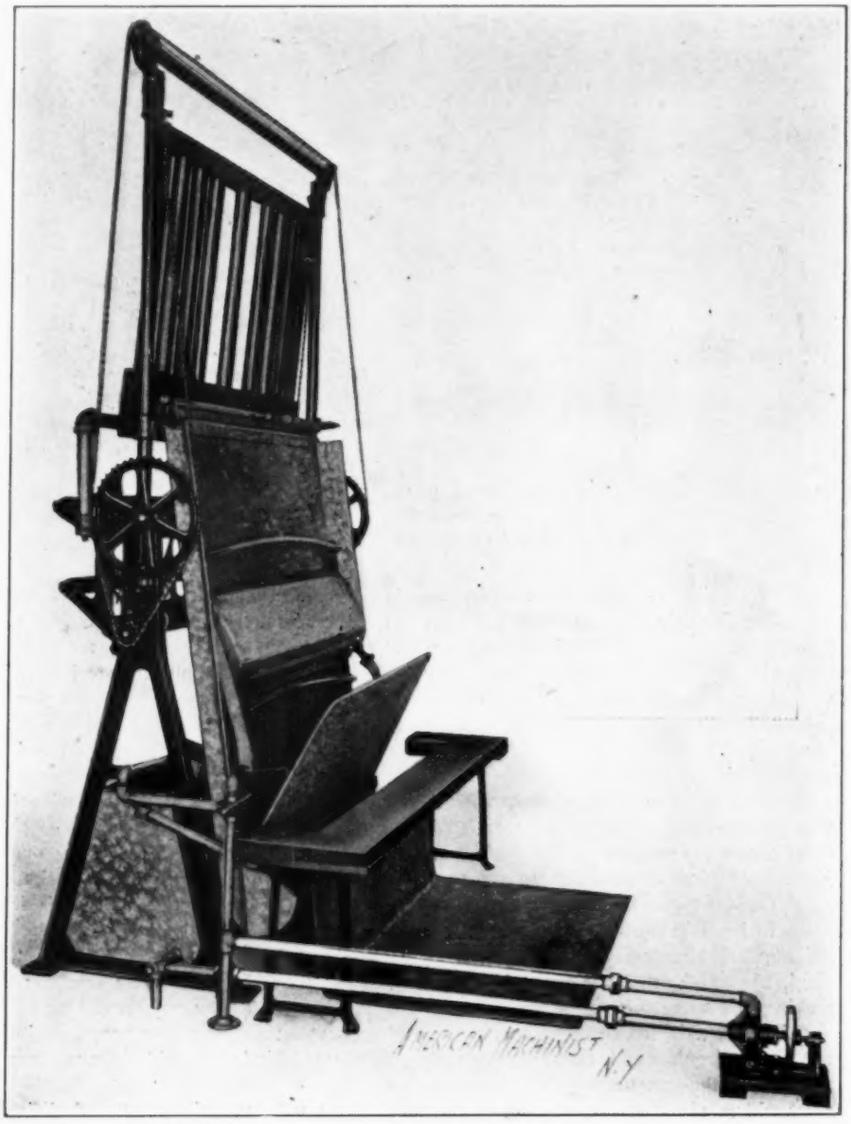
The tension of the sand belt is controlled by a toggle, making it convenient to take off and replace belts. To increase or reduce the tension a nurled nut is close to hand over the toggle. The tension is not rigid, but has a cushion spring in the toggle so that no undue strain need come on the belt.

The table is adjustable vertically and horizontally, all movements being obtained easily and rapidly by handwheel and not requiring the use of a wrench in any case. Careful attention has been paid toward making this as convenient as possible to the patternmaker. It is designed and built by Alfred R. Benn, 1757 Seventy-second street, Brooklyn, N. Y.

## Blueprint Washing Machine

The blueprint washing and drying machine illustrated herewith is made by Williams, Brown & Earle, Philadelphia, Penn., to accompany their blueprinting machine. This is attached to the ordinary water pipe in the room and can take the blueprints as they come from the printing machines, wash them thoroughly and pass them over vertical gas-drying arrangements at the top, delivering the prints at the rear either separately on a table, or in a continuous roll. When geared up with the electric blueprinter, the combination prints, washes, and dries at the rate of 4 feet per minute. This machine only washes the paper on its face side, and although all the chemicals are thoroughly eliminated the paper is not soaked to the same extent as in a tank, and they are said to dry flat and with very little tendency to buckle. This greatly decreases the distortion, which is quite a point on some drawings where scaling is resorted to.

A tank containing the potash is shown under the machine and is connected with a small pump which pumps this into a small oval shield, from which most of it flows by gravity back to the main tank.

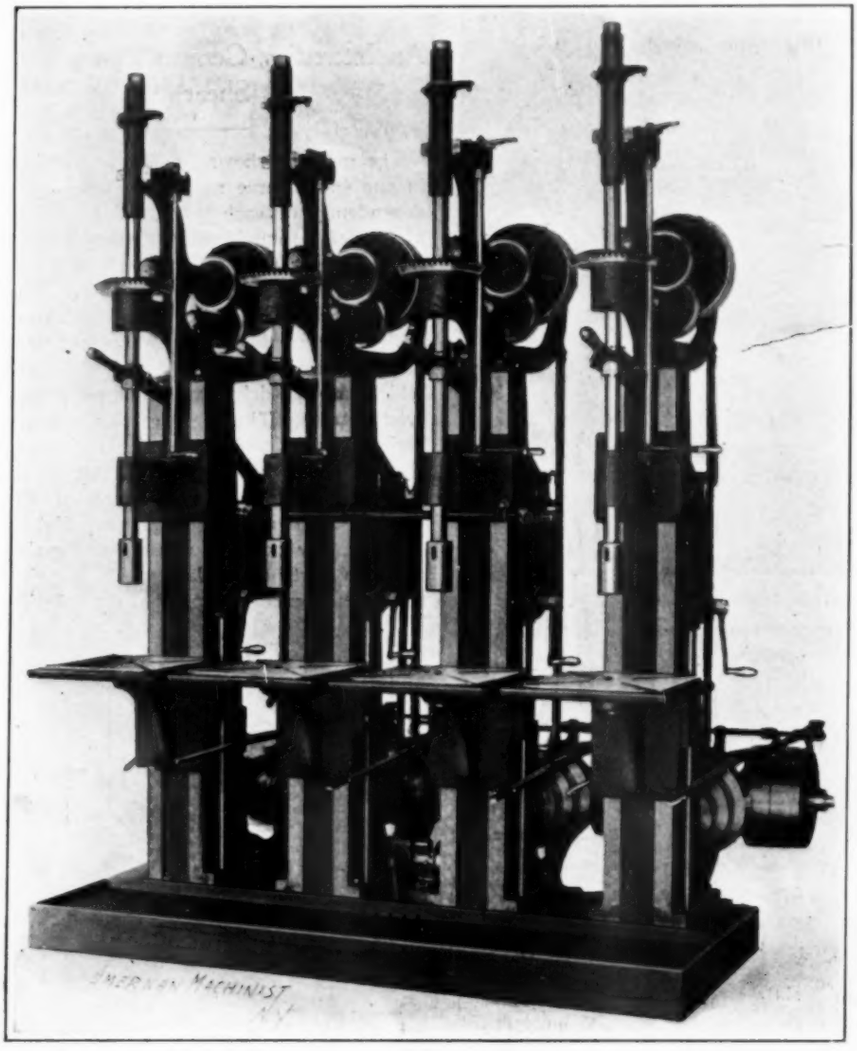



BLUEPRINT WASHING AND DRYING MACHINE

so that comparatively little of the solution is used, which considerably reduces this expense.

## A Drilling Machine Specially Designed for Threading Taps

We illustrate herewith a new type of drill press specially designed for the use of manufacturers of taps. The tap blank is inserted in the end of the vertical spindle, as the tap itself would be in the case of a drill press used for tapping, and



MACHINE DESIGNED FOR THREADING TAPS

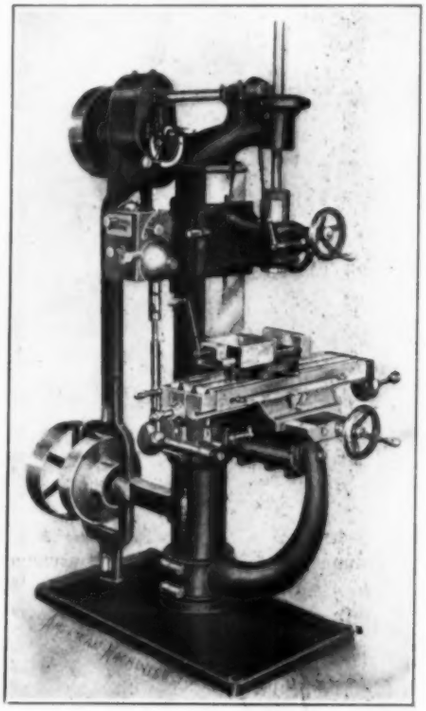
is then driven through a die bolted to the table beneath. In actual use, two dies are employed in succession, one a roughing die and the other a finishing die. While the machine resembles, in many respects, an ordinary drill press, it differs noticeably in that the automatic feed is secured by means of a lead screw on the top end of the spindle, which is extended through the crown gear for that purpose. The upper end of the spindle is turned down to a smaller diameter than the remainder and a threaded sleeve, serving as the lead screw, is fastened upon it by means of a lock nut, this removable sleeve having the same lead as the tap which is to be threaded. When the tap blank has been driven through the die, it drops out and at the same moment an adjustable tripping dog clamped on and revolving with the threaded sleeve throws out of mesh the nut which engages the sleeve, whereupon the spindle is returned automatically, by a counterweight, to its original position and is ready to be supplied with another blank. The downward feed is thrown in again by means of the hand lever at the side of the lower spindle bearing.

The lower end of the spindle is fitted with a spindle head having the usual Morse taper and a special fixture for holding the square head of a tap blank. The machine has four spindles and, therefore, provides for two sets of dies. It is readily taken care of by one operator. Each of the spindles is attached to an independent column and is equipped with independent driving mechanism, although all four columns are bolted to a common base plate. Inasmuch as the hobbing of tap blanks does not require a high speed, the back gears are designed to be left permanently in mesh, changes of speed being made by shifting the belt on the cone pulleys. Each lower cone pulley is driven at right angles from a shaft having a tight and loose pulley, and hence any spindle can be stopped independently of the others by means of belt-shifting levers projecting under the tables. Each table can also be lowered or raised independently of the others by means of a screw passing through a nut attached to the table and provided at its upper end with crank-operated bevel gears.

The columns supporting the spindle heads and driving mechanism are of the box type and substantial. The upper head is fitted with an additional back brace supporting the outer end of the cone-pulley shaft, for rigidity. One pump supplies oil to all four spindles, and drainage from the tables returns to the oil-pan base, so that the lubricant can be used over and over. This machine has been designed and built by the Hoefer Manufacturing Company, of Freeport, Ill.

## Drilling and Milling Machine

The halftone illustrates the No. 2 Knight drilling and milling machine, which is of the same general design as the original Knight machine, but is capable of operating upon work of various kinds much larger than can be handled in the first machine and that requires to be drilled, bored or milled; or which requires any two or more of these operations that are to be done at a single setting of the work, to save time ordinarily lost in resetting the work to perform a second

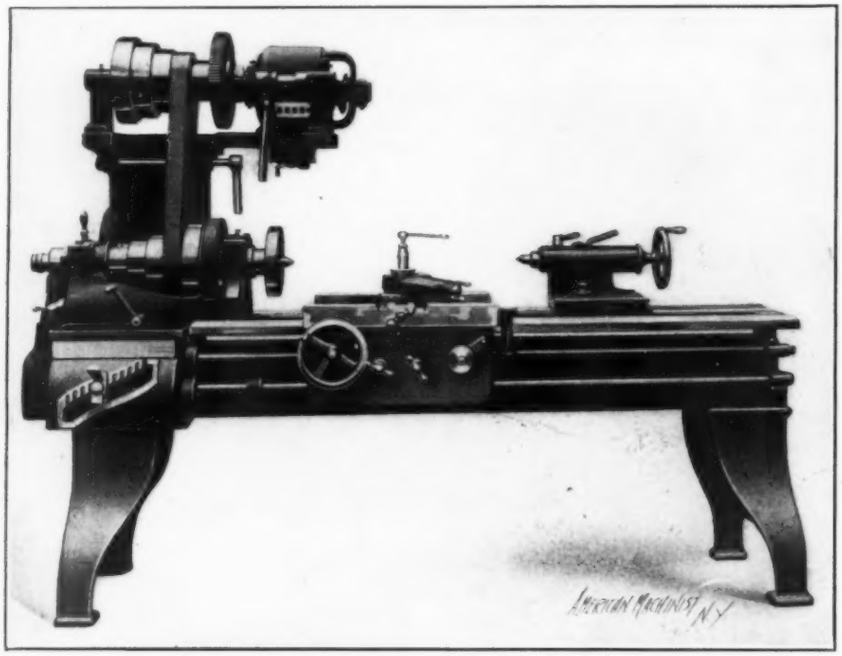


DRILLING AND MILLING MACHINE

operation of a different nature, either drilling, boring or milling, after one of the operations has been carried out and one or both of the others is needed. This machine is so constructed as to provide for any one of the operations being accomplished with a drilling, boring or milling tool at right angles to, parallel to, or at an intermediate angle relative to the plane of the table, conditions that are made possible due to the table being tiltable, and so mounted as to permit of its being quickly adjusted. The maker is the W. B. Knight Machinery Company, St. Louis, Mo.

## Motor Driven Lathe

The 16-inch by 8-foot lathe shown is the latest development of the W. P. Davis Machine Company, Rochester, N. Y., having a quick-change feed and self-contained motor drive, which can be attached to any size lathe. The lever under the motor shelf controls the tension of the endless belt used for driving, it being loosened or tightened at will. The lever in front of the motor controls the clutch in the large spur gear so that the lathe can be stopped independently of the motor. The feed provides for threads of from 3 to 40 per inch, and it will be noted that all lathe gears are carefully guarded. A thread-catching indicator is provided on the carriage.



MOTOR-DRIVEN LATHE WITH QUICK-CHANGE FEED

## An Interesting German Punch and Shear

The machine shown in Fig. 1 combines in one frame three rams, which work independently of each other, all driven by a common eccentric shaft. All three can work at once, but each can be thrown in and out independently of the others. The machine is driven through fast and loose pulleys out of the workmen's reach; provision is also made for electric drive, in which case the drive is through a rawhide friction disk. The three rams are counterbalanced by weights (or by springs, if desired), and when thrown out by a weighted lever at any portion of the stroke, attain and remain in the highest position. By means of a wedge and spring the two parts of a plate which is being cut are opened apart, the cut portion

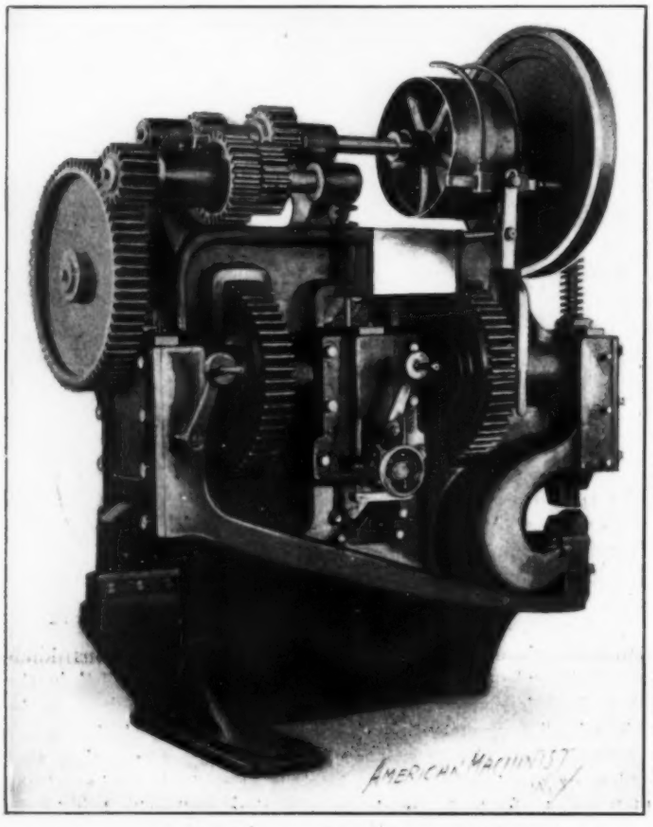
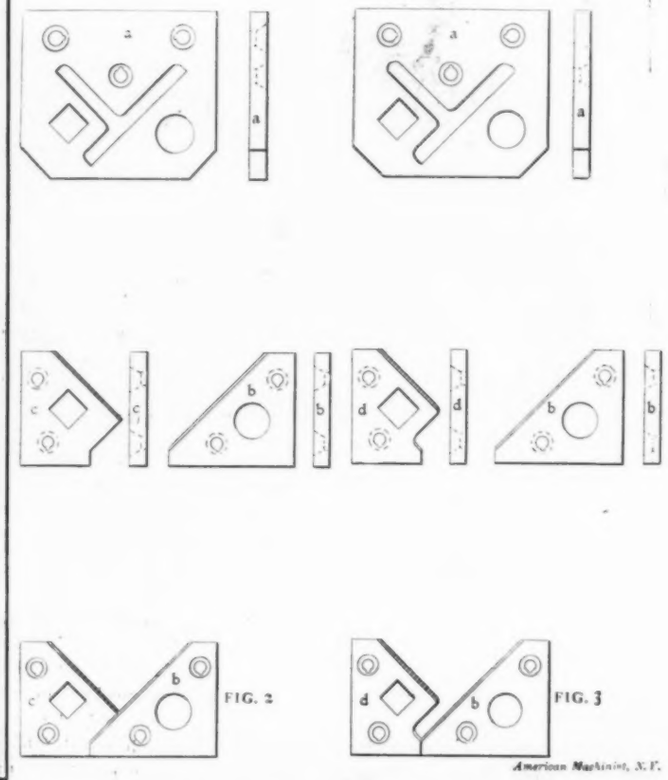


FIG. 1. AN INTERESTING GERMAN PUNCH AND SHEAR




KNIVES FOR ANGLES AND T-BEAMS

going down under the angular portion of the frame. A special arrangement enables the cutting of several different profiles with one knife. The upper knife *a*, Fig. 2, is made of one piece, and besides the openings for round and square bars has one for T's. The lower knife consists of two parts, *b* and *c*, and has the openings for round and square bars, but for cutting angle iron the two parts are put together so as to form a right angle. Fig. 3 shows how they are assembled for cutting off T's. The upper knife *a* is the same as in Fig. 2, and so is the right-hand under knife *b*; but instead of the knife section *c* there is used the section *d*, which has a lateral opening for the profile of the T. By the use of special knives channel iron can be cut off.

The punching arrangement has a very deep throat, and can punch channel, angle, I- and T-beams well into the corners. For punching large or small profile iron in the flange an auxiliary under die is used. The maker is F. X. Honer, Ravensburg, Württemberg, Germany.

## Special Tools for Boring a Universal Joint Hanger

By M. Dawson

The universal or ball-joint hanger for supporting the transmission shaft in the Rambler automobile is shown in its special chuck in Fig. 1, and the special tools for machining the same are shown in the other accompanying sketches. The hanger is made of two semi-steel castings that

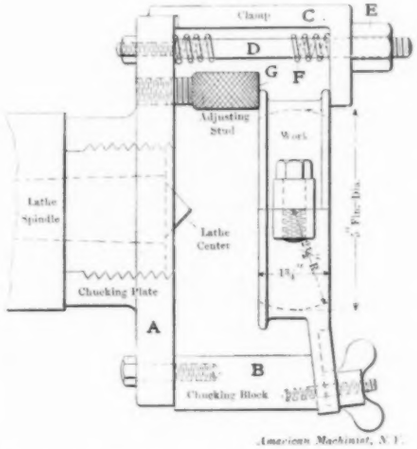



FIG. 1. UNIVERSAL JOINT HANGER IN CHUCK FOR BORING

are bolted together on the center line. The joint faces are machined and the lugs are drilled and tapped, after which the two halves are bolted together for the boring operation, as shown in Fig. 1.

This piece is, owing to the design, very unhandy to chuck in a way that will stand a heavy cut and meet the speed requirements in the production of this class of work. With the chuck and tools shown herewith, however, the job is satisfactorily done.

In Fig. 1, *A* is a cast-iron face or chucking plate machined all over; *B* a cast-iron chucking block secured to the face plate with two bolts. The outer face is shaped to receive a flange that is part of the hanger. In this flange are two machined holes, and through these holes are two stud bolts. One end is secured in the chucking block *B*, and the other end holds the winged nuts for clamping the flange. *C* is an L-shaped steel clamp ½x1¾ inches; *D* a clamping shoulder bolt reduced and threaded to fit a tapped hole in the face plate and secured with a locking nut; *E* the clamping nut; *F* an expansion spring over bolt *D* between the face plate and clamp *C* for the purpose of keeping *C* under tension at all times, thus allowing easy and handy manipulation of the clamping parts.

The finished hole in the hanger is ball-shaped and 5 inches in diameter. A

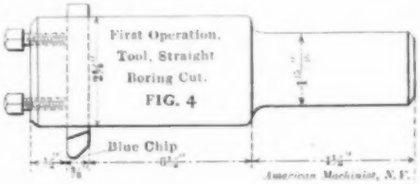



FIG. 2. AN EFFICIENT TOOL FOR ROUGH BORING

straight hole is first made with the boring tool, shown in Fig. 2, and it leaves the least possible amount of stock to be removed by the circular cutting tool.

The adjusting stud *G* provides a simple and quick means for correcting any irregularities in the casting, or the assembling of the two halves which would cause the circular portion of the hanger to run out of truth.

In Fig. 3 is shown in plan and elevation the circle boring tool. The holder is machine steel forged as near as possible to the required shape and afterward finished all over. I have given a few dimensions so that an idea can be obtained as to its size.

The shank is 4½ inches long and 1 15/16 inches in diameter to fit the turret head in a screw machine. The gear *H* is a flat disk with 4-inch pitch diameter, 18 pitch and 36 teeth in half the circumference, the tool half being left blank. Gear *I* is 2 inches pitch diameter, 18 pitch, 36 teeth. The thickness of the finished gears *H* and *I* is ⅞ inch; the width of face is ¾ inch, and the bottom is recessed, as shown to allow a clearance for chips.

The gears are mounted on stud bolts, as shown by *K*. The pinion *J* has an extension sleeve that fits loosely in a hole in the holder and is flush with the bottom. *L* is a ¾-inch cold-rolled shaft threaded at the bottom for adjusting and locking nuts. The pinion *J* is secured to this shaft with a key; *M* is a forged bracket fitted and bolted to the holder, as shown. The upper end is drilled to receive a

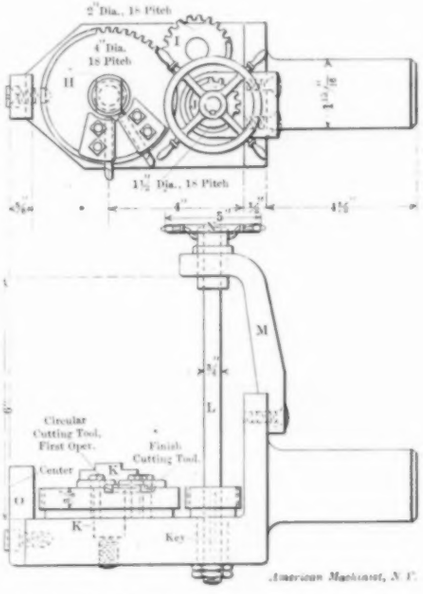



FIG. 3. PLAN AND ELEVATION OF TOOL FOR CIRCULAR FINISHING CUT

brass bushing, through which the shaft *L* passes and *N* is a hand wheel keyed to shaft *L*.

The cutting tools are ⅜x⅜-inch Blue Chip steel clamped in recesses in gear disk *H* by two machine-steel plates. *O* is a machine-steel piece machined and secured to the holder by a screw. In this piece is a countersunk center that fits the male center in the lathe head. The purpose of this is to provide an outer support for the holder and also a tool gage. When the centers come together the cutting tools are in the correct position to start work. The intermediate gear *I* causes the tool-holder gear *H* to rotate in the same direction as the feed wheel *N* and the decreased diameter of *I* and *J*, in relation to the diameter of *H* provides a means of steady control of the cutting tools.

To prevent, as much as possible, the fine chips from getting into the gear teeth or under the gear disks, all of the working parts are covered with a sheet-brass cap, which is constantly flooded with a good grade of lubricant that serves as a wash and keeps the tools cool, and on account of these small chips causing much trouble it is important that the recess is cut in the bottom of the gears, as shown in Fig. 3.

With these tools we have turned out a large number of these ball joint hangers which were in every way satisfactory.

# Trade Opportunities in the Smaller Latin American Republics

By M. de Moreira

The small republics in Latin America present also to American manufacturers opportunities which, though not so numerous as in Brazil or Argentina, are nevertheless in one way a good deal more promising, as manufacturers in general do not busy themselves very much with these small countries, leaving, therefore, a freer field to the enterprising man who does not fail to grasp everything that comes within his reach.

### Bolivia—Large Railway Projects Proposed

Bolivia, for instance, needs American machinery in the construction of its railway system. The most important of the Bolivian lines is the Viacha-Oruro railway, which places the Andean table land in railway communication with the Chilean port of Antofagasta. This railway passes through the richest mining zones and agricultural lands of the republic.

The railway system of Bolivia, when completed, will comprise 1300 miles, but at present date only 400 miles are in operation. These lines connect with the Chilean railways as well as with the Peruvian, Argentinian and Brazilian lines.

Preliminary work on the Brazilian railway from the Beni region of Bolivia in the northern part of the republic is being started. This railway will be about 300 miles in length and will penetrate a rich and virgin region abounding in rubber, cabinet woods and many other forms of natural wealth. The work on the Madeira-Marmore railway, though started, is far from being finished. This line will connect the Marmore river with the Madeira river and pass around the falls, which have, heretofore, made a direct commercial route from Bolivia to the Atlantic ocean an impracticable matter. This line is being constructed by American capital and manufacturers should have no difficulty in presenting their products to the New York syndicate.

The French are also building a railway which will connect the railway system in the State of S. Paulo with Bolivia. A little over one-third of the road has been built and the rest must be finished within two years.

Another railway under construction will connect Arica, Chile, with La Paz, Bolivia. The work has been commenced at both ends and the line will be 140 miles in length.

### Dominican Republic

The United States leads in exports to the Dominican Republic. This country is not only formulating extensive irrigation plans for the adequate cultivation of its land areas but has under consideration the construction of such railways as will facilitate the transportation of its products to the ocean. There are at present three railroads in operation in the Dominican Republic: one from Puerto Plata to Santiago, which is 42 miles in length; another from Santiago to Mocha, which is still under construction; and a third one about 80 miles in length from Samana bay to La Vega. The first two are owned by the Government and the other by British capitalists.

In the near future the Government will build a line from Monte Christi to Santiago and another from Mocha to La Vega. The former will follow the valley of the Yaque del Norte, opening a section extremely rich both in argicultural and timber products. The latter will connect the Government railway with the Sanchez-La Vega road, thus putting into communication all the important towns of the northern half of the republic. Nearly all the equipment now in use came from Belgium. It is, however, so old, that American manufacturers of railroad machinery and of rolling stock ought easily to make sales.

Besides railway machinery, equipment, etc., manufacturers of textile machinery have a good field there, though a restricted one. American manufacturers have already made some good sales of cotton machinery.

### Guatemala—Worth Cultivation

As in the Dominican Republic, efforts are being made to facilitate communication and transportation. A short time ago a contract was signed which provides for the construction of a railroad from a point on the existing Occidental railroad to the Mexican frontier, including also the construction of a bridge across the Suchiate river.

Such a road, when built, will give Guatemala through railroad communication with the United States and but for the difference of gage between Mexican and Guatemalan roads would send all produce from southwestern Guatemala over the Pan-American and Mexican roads to Coatzocoalcos as a shipping point. All existing Guatemalan railroads are of three feet gage, though the greater number of the bridges were constructed with a view of possibly widening the tracks to standard gage.

The Central railroad of Guatemala will construct for the account of the Government a railroad from San Felipe to Quezaltenango.

Another important work is the completion of the Guatemalan Northern from Puerto Barrios on the Atlantic to Guatemala City, necessitating only a line from Zacapa, Guatemala, to Santa Anna, S. Salvador, to connect with the S. Salvador railway. As the territory of Salvador touches the Pacific ocean only, this road will be very important, as now it requires from 15 to 30 days' time to make the journey from S. Salvador to New York. The advantage would be still greater for freight shipment. To bring this about it has been deemed necessary to build about 100 miles of road, half in Guatemala and half in S. Salvador. A few months ago Guatemala granted the concession to build the railway in its territory, and the Salvador Railway Company will build it. The Guatemala Northern Railway Company is an American concern and the other is owned and managed by English people.

Undoubtedly all necessary machinery ought to be purchased here, even though one of the companies is owned by English capital, and it remains for us to bring this about by interesting ourselves in the progress of these enterprises.

### Costa Rica

The Government of Costa Rica has authorized the Cartago Electric Light Company to import free of any duty, the necessary materials, supplies and rolling stock for the construction and operation of an electric railway between Cartago and San Jose. Though Costa Rica does not offer us much actually, this item is worth while noting.

### Honduras—A Field Specially Inducive to Mining Machinery

Honduras is somewhat more generous. The construction of the line from Trisillo on the Atlantic to Tegucigalpa is being started. The total length of the road when completed will be about 350 miles of standard-gage track. The material must be purchased in this country.

Mining, however, offers more advantages to our manufacturers. M. E. Montis, a well known engineer, thinks there is a vast number of opportunities there and forecasts that this republic will be a great producer of minerals. As it is well known, gold, platinum, silver, copper, etc., also coal of varying quality, occur in Honduras. The exploitation of this mineral wealth has never been adequately undertaken.

As yet the application of modern methods of extracting and working is very limited. The best equipped property is that of the Rosario Mining Company, from which $12,000,000 has been produced. Modern machinery is absolutely necessary to develop the wealth buried in the ground and as this country is not far from the United States, enterprising mining-machinery manufacturers ought to send a representative on an investigating tour, the result of which would undoubtedly be beneficial to the Hondurians as well as to themselves.

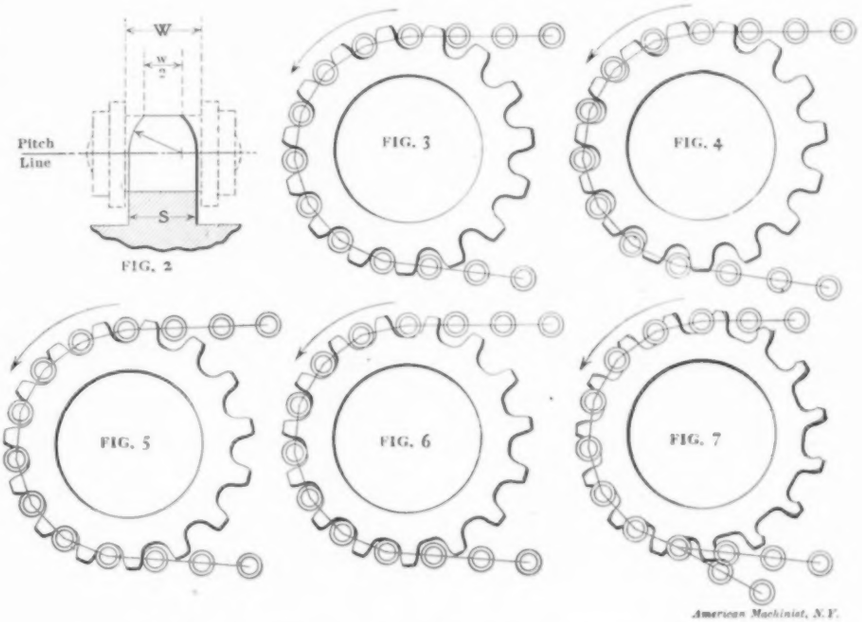
# Sprocket Tooth Outlines and Their Relation to Smooth Driving

By Curtis C. Myers

After inspecting, during the past two years, a large number of chain drives using block and roller chains, composed of accurately made parts with hardened bearing surfaces, it has been found that there is a wide divergence in methods of cutting sprockets and selecting chains suitable for the particular service to which they are applied. There is also a lack of accurate knowledge as to sprocket-tooth outlines suitable for drives operating at high chain speeds under severe conditions of service.

Sprockets should be cut with at least 12 teeth if possible, as both chain and sprockets wear much longer and chains operate more quietly over large sprockets than over small diameters. The smaller a sprocket the greater the bending movement of the chain in operation and, therefore, the greater the wear.

Few chains are ever worked under a strain great enough to permanently elongate the metal in the side links and blocks, and the greatest factor in the destruction of a chain is the movement of the joints due to the chain coming into and leaving contact with the sprocket. It is evident that the smaller a sprocket is, and the greater the ratio in the sizes of the driver and driven sprockets, the more the relative movement of one link to another.




PROPERLY CUT SPROCKETS AND WEDGING WEARING ACTION OF CHAIN ON THOSE NOT PROPERLY CUT

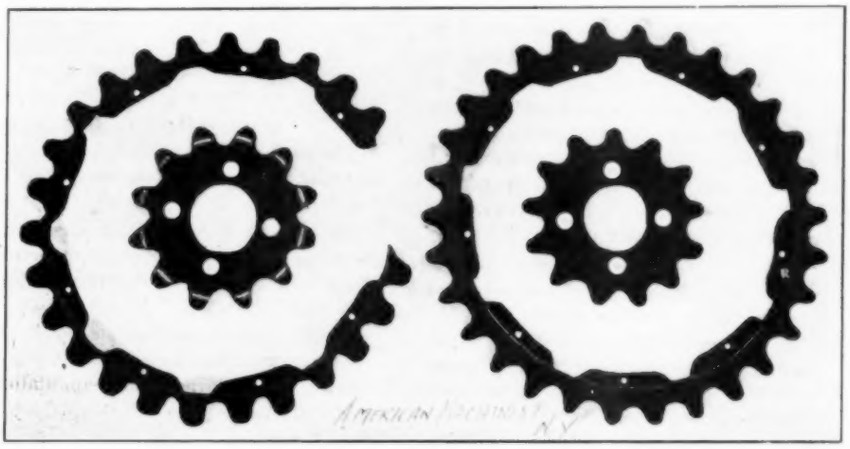


FIG. 1. SPROCKETS TAKEN FROM A FRENCH AUTOMOBILE

The effect of running a chain that has too great a pitch for the sprocket it is working over, is to crack the rollers and cause the bushings to work loose in the side bars. Other bad effects are hard running, high friction loss, and noisy operation due to the chain clinging to the sprocket teeth and snapping off.

The wedging action of the roller on the sprocket tooth is very great. Many instances have been seen where the metal of the tooth has been hammered out at the sides and end, and the rollers reduced in diameter on account of this wedging action.

At the right of Fig. 1 is shown a pair of sprockets taken from a French automobile. They were machined so that the chain rollers would wedge down into position with no clearance; the idea being that the chain would run more quietly. But the effect was to make a noisier drive.

In this particular instance, in less than a month's operation, the chains were ruined and the sprocket broken, as shown. These sprockets were replaced by a pair of sprockets cut with clearance, as shown at the left of Fig. 1. These have given every satisfaction besides making a much more quiet drive and no chain troubles.

Too much care cannot be shown in chamfering the end of a sprocket tooth. There are various standards in use by different chain manufacturers. The one shown in Fig. 2 is a suggestion which may be helpful.

The important thing is to take off enough of the tooth point, as the chain is liable to sway while running, and if the sprockets are not exactly in line the chamfered tooth point helps to cut down the noise. On motor cars this is important, because one side of the car is liable to be much lower than the other, and thus the sprockets are thrown out of line very noticeably. The wear on the chain is greater the shorter the chain.

Sprockets must be cut considerably thinner than the width of the chain to allow for variations in alinement and accumulation of dirt between the chain links. A suggestion for thickness would be to make sprockets for chain up to one-half inch wide, one thirty-second of an inch less than the chain width; and for sprockets for wider chains at least one-sixteenth of an inch less than the chain width.

In Fig. 3 is shown a sprocket cut correctly with no clearance, and the chain correct in pitch and fitting the sprocket. This condition would work satisfactorily if there were no wear, no elongation and no dust or dirt to clog up the chain.

The result of running such a drive is shown in Fig. 4 where it is seen that the chain does not touch all of the teeth at the base diameter and thus there is a wedging action of the roller and tooth that results in broken rollers and noisy running. This is due to the elongation of the chain.

Fig. 5 shows a sprocket cut with clearance; pitch of sprocket and chain correct; rollers seated, and each tooth taking a portion of the chain load. This condition

of chain and sprocket is most satisfactory for smooth running and long life of chain, with a minimum of broken parts. When the chain wears and elongates it still fits the sprockets as shown in Fig. 6. There is no wedging action as in Fig. 4, and the chain engages with the sprocket and leaves contact without snapping or wedging.

When a sprocket tooth has worn sufficiently to cause a hook to the portion of tooth above the pitch line, a serious condition exists as there is a wedging action on the rollers, both upon beginning and leaving contact, and no chain can long resist this severe strain. New chains should never be put into sprockets which are worn similar to the one shown in Fig. 7, as the chain is quickly ruined and an unsatisfactory drive is sure to result.

Sprockets should be cut correctly and with ample clearance, particularly above the pitch line, as the action of a chain is quite different from that of two spur gears.

It is the common practice with sprocket manufacturers to use a smaller cutter than is designated to cut a given sprocket. For instance, a ten-tooth sprocket should be cut with a cutter marked nine teeth.

It is to be regretted that there is no standard among chain manufacturers for the correct outline of sprocket cutters and amount of clearance, for various sizes of chain. Neither do the cutter manufacturers agree as to cutter outlines, and they will furnish cutters with any amount of clearance or no clearance, depending upon the whim of the purchaser. The results of this arrangement are naturally not satisfactory or uniform.

Another frequent cause of chain noise and excessive wear is due to the chain side bars coming in contact with the hub of the smaller sprocket, or hitting on a trace or guard.

The effect on the chain is to wear the edges of the side links and cause crystallization of the metal, due to the great number of vibrations. When the hub of the sprocket is so large that the chain cannot seat properly, there is an elongation of the chain, due to a too large base diameter of the sprocket.

In conclusion, if it is clearly understood that the high quality roller and block chains now on the market require correctly cut sprockets, properly proportioned for the particular conditions of service they are to work under, there will be a large increase in their use for power transmission, and the troubles now incident to incorrect installations could be wholly obviated.

---

The new wireless telegraphy station to be erected in Washington for the United States Navy is to be the largest station of its kind in the world, and will cost about $300,000 to install. It is proposed to cover a radius of 3000 miles.

## The Newer Sheffield Steels

By I. W. Chubb

Among the Sheffield firms who have introduced newer high-speed steels, may be mentioned W. Jessop & Sons, Ltd., Brightside, who, as a matter of fact, have marketed such a product since May, 1907. Tests made in my presence on a bar 7¼ inches in diameter and 9 feet long, of 4 per cent. carbon Siemens-Martin steel, show incidentally that water-hardening may occasionally present great advantages. It is a fact, however, that most of the Sheffield steelmakers are not very insistent on water-hardening claims unless very carefully performed. The material is thought to be too dense to stand the treatment.

The ordinary high-speed steel made by the firm was first tested, in the shape of a tool made from 1¼-inch square steel. The testing lathe had centers 12 inches high and was driven by a 35-horsepower electric motor. As a preliminary, a roughing cut was taken over the bar. It trued most of the length, but left something like a quarter of the surface with scale showing.

Disregarding one or two other short runs, the ordinary high-speed steel tool took a cut ¼ inch deep, that is, ½ inch on the diameter, with a feed of 12 to the inch, at a speed of 80 feet a minute. The bar was turned for a length of 13½ inches before the tool gave out.

Their newer steel, "Special Arc," was then tried in a tool that was air-hardened, with the same speed, feed, etc., and it cut a length of 11 inches. It should be noted, however, that the bar was held at one end by a dog chuck and supported at the other end in the poppet-head center; therefore there was a considerable amount of chatter as the middle of the length of the bar was approached. Moreover, this tool was cutting about one-third of the diameter on the scale.

Another tool of the same material, but water-hardened, cut a length of 28½ inches. Here, however, a piece of metal, being cut, fused itself on the tool and the attendant, mistaking a signal, stopped the motor.

Another "Special Arc" water-hardening tool was then secured in the rest. Starting from the poppet-head end, with the depth of cut, feed and speed the same as above, it cut a length of 65 inches. When run into the shoulder, left from a previous cut, the tool was forced out. On being more firmly secured, the tool took a cut ½ inch deep, or 1 inch on the diameter, for a length of about 8 inches, at an actual cutting speed of 60 feet per minute, on the smaller diameter. The fuse then blew out, and the motor stopped. The tool, however, was in excellent condition at the end of the test.

Another Sheffield firm, the Strong Twist Drill Company, quite a new concern, is manufacturing twist drills of carbon steel with which the following results have been obtained: A 7/16-inch drill, which I took casually from stock, was run at 375 revolutions per minute, with a feed rated at 4 inches per minute, and this was sent several times through a 1-inch steel plate of 34 tons tensile steel. At the same speeds and feeds 11/32- and 5/16-inch drills also drilled successfully.

The machine was then speeded up, by altering the positions of the belts, so that the 7/16-inch drill ran at 600 revolutions, or, say 68 feet per minute, with a feed of 8 inches per minute, and holes were successfully cut in the same material by all three drills. In this case the feed works out at 0.013 inch per revolution. The firm makes drills, from ⅛ to 4 inches diameter, of their own carbon steel, or of high-speed steels.

Finally, Darwin & Milner, Sheffield, are introducing their A.B.C. steel for the production of chisels, riveting tools, etc. The name is thought to be applicable owing to the ease with which the material can be forged. It is heated merely until sparks are given off, and for hardening is dipped into water (preferably cold), with the steel at any heat from white to a good cherry red.

To exhibit the qualities of this steel, it was shown to me in the following way: A short length was cut from a 1x⅝-inch bar; this was forged on one end to a chisel-shape in 20 seconds; hardened by being dipped immediately in water, and then tried on a bar of 1 per cent. carbon steel, unannealed, by being hit a number of times with an 11-pound sledge hammer. The chisel was then wedged across a length of bar iron ¼x1¼ inches, and finally tried again in the same way as before and on the same steel bar.

The idea was to show the toughness of the material, and it was noted that there was no serious effect on the edge. No head was formed on the chisel, this end being left as cut from the bar. In an ordinary chisel, should the end tend to "mushroom," the material is simply raised to a welding heat and hammered to shape. Finally a length of material was formed as a chisel, and used in a pneumatic machine for chipping out defective places on a bar of high-speed steel. The end was then heated and turned over, raised again to welding heat, formed again to chisel shape, and used once more for pneumatic chipping.

Reference was made in an article appearing on page 586, Part 2, Volume 32, to a research by Prof. J. O. Arnold, of Sheffield University, on a product intended to improve the qualities of steel. I am unable to publish details of this investigation, owing to the University authorities being unwilling, but to prevent guessing there can be no harm in stating that the chief ingredient was vanadium.

## George T. C. Lamar

George T. C. Lamar, for a number of years active in the machinery field, died on July 25. Mr. Lamar was considered a first-class machine-shop man, and during late years had been employed in reorganizing and regenerating old established plants. He made a special study of automatic machinery, and was an occasional contributor to our columns.

## Forthcoming Meetings

International Association for Testing Materials, fifth congress, Copenhagen, Denmark, September 7-11.

National Machine Tool Builders' Association, fall meeting, October 12 and 13; headquarters, Hotel Imperial, New York City. P. E. Mentames, secretary, Springfield, Ohio.

## Business Items

Variable Speed Clutch Company, Milwaukee, Wis., has opened an office at 67 West Washington street, Chicago. H. R. Swartley, Jr., manager.

B. C. Ames & Co., Waltham, Mass., manufacturers of precision bench lathes, bench milling machine, dial gages, etc., has just moved into its new reinforced steel concrete factory, on Lexington street. It has more than tripled its capacity in this new factory and will be enabled to fill its orders promptly.

The Bristol Company, Waterbury, Conn., has established a branch office in the Frick building annex, Pittsburg. One of their representatives will be located there to coöperate with customers whose plants are in the immediate vicinity of Pittsburg, including New Castle, Youngstown, Wheeling, Scottdale, Johnstown and Oil City.

The International Acheson Graphite Company is enlarging the output capacity of its branch works in Niagara Falls, Ont. This company has for many years operated a Canadian branch with facilities far in excess of the demands of the Canadian trade. It, however, recognizes in the hydro-electro development now so active throughout the Dominion and the new trade spirit and energy everywhere present throughout Canada, an indication of additional industrial enterprise, and it is to meet the prospective demand for its product likely to be created by the new conditions that it is increasing the size and output capacity of its plant in Niagara Falls, Ont. A new furnace room providing for a 1000-horsepower unit is being built, and on completion the new furnace installation will be placed in operation.

As telegraphed from Melbourne a few days ago, the Pratt & Whitney Company has taken a contract to equip a small arms factory for the Australian government. The Commonwealth sent a special expert to England to investigate the subject, and the order was placed in London. The Pratt & Whitney bid and one of the other competitors were almost the same in price; the third bidder was very much higher. The competition narrowed down to a question of efficiency. The Pratt & Whitney Company finally succeeded in demonstrating that they could make a gun in just about half the working hours that could be done by either of their competitors. This conclusion was arrived at by the Australian expert after a long and painstaking investigation. The plant is to be delivered in Australia in one year from the date of the signing of the contract.

The Dwight Slate Machine Company was incorporated at Hartford, Conn., June 2, 1909, with an authorized capital of $50,000, and has acquired the plant and business formerly conducted by the old Dwight Slate Machine Company for the past twenty-five years. The president of the organization is Samuel E. Elmore. He is also president of the Connecticut River Banking Company, of Hartford; treasurer of J. R. Montgomery Company, of Windsor Locks, Conn., and director in several other leading financial and manufacturing interests in the city of Hartford and surrounding districts. The other officers are: Charles B. Elmore, vice-president and secretary, and Martin Welles, treasurer. The new company will continue to manufacture the same general line of sensitive drilling machines, automatic gear cutting machines and marking machines. It is also their intention to make a specialty of and advance the sale of their line of automatic feed multiple spindle drills adapted for high speed production. A new pamphlet is now being prepared giving full details concerning these machines, which will be mailed upon request.

## Business Opportunities

The Sparta (Wis.) Iron Works, will erect an addition to its plant.

The Billings (Mont.) Foundry Company is erecting a new plant.

The La Crosse (Wis.) Pure Food Company will enlarge its plant.

Winston Bros. & Co., St. Paul, Minn., is to erect a new machine shop.

Heyl & Patterson, Pittsburg, Penn., will enlarge their machine shop.

The Rhinelander (Wis.) Paper Company will erect an addition to its plant.

Douglas & Co. will erect a $500,000 starch factory at Cedar Rapids, Iowa.

The Wisconsin Refrigerator Company, Eau Claire, Wis., will enlarge its plant.

A new factory will be erected for the Rising Sun Wagon Works, Philadelphia, Penn.

The Diamond Lumber Company, Green Bay, Wis., will rebuild a sawmill recently burned.

The plant of the New Bedford (Mass.) Cordage Company was practically destroyed by fire.

The A. T. Way Leather Company, Danversport, Mass., will build a four-story addition.

The Zulu Knitting Company, Two Rivers, Wis., is making improvements at its plant.

Messrs. Bratton, Davidson, N. C., will establish a machine shop and woodworking plant.

The Allis-Chalmers Company, Milwaukee, Wis., has had plans prepared for a new forging shop.

The K. H. Wheel Company, Detroit, Mich., has completed plans for a new factory building.

The Wabash Screen Door Company, Memphis, Tenn., will build a $35,000 addition to its plant.

The Houston (Texas) Belt and Terminal Company will erect a roundhouse, yard office, etc.

The Kneller & Kaplan Company, Beloit, Wis., manufacturing go-carts, will move to Monroe, Wis.

The Victor Automobile Manufacturing Company, St. Louis, Mo., will erect a $12,000 factory building.

The Boehme & Raugh Paper Mills Company, Monroe, Mich., has completed an addition to its plant.

The Crescent Tool Company, Jamestown, N. Y., is preparing plans for a new machine shop and factory.

The William Strange Silk Company, Paterson, N. J., has awarded a contract for the erection of a new mill.

The National Automatic Tool Company, Dayton, Ohio, is to locate in Richmond, Ind., where a new plant will be erected. The company manufactures drilling machines, etc.

The Rauch & Lang Carriage Company, Cleveland, Ohio, has had plans prepared for a new machine shop.

The Dodge Manufacturing Company, Mishawaka, Ind., is building an addition to its machine shop.

The Cleveland (Ohio) Foundry Company has filed plans for a five-story addition to cost about $50,000.

The Vest (Va.) Pulp and Paper Company is enlarging its plant and contemplates installing steam turbines.

The Federal Rubber Company, Cudahy, Wis., will erect a plant for the manufacture of automobile tires.

The National Malleable Casting Company, Cleveland, Ohio, has taken out a permit for a $30,000 addition.

The Caloric Company, Janesville, Wis., manufacturing tables and fireless cookers, will build an addition.

J. W. Zarros, Cincinnati, Ohio, manufacturer of amusement goods, is about to install a steel plant, it is reported.

The Fond du Lac (Wis.) Mirror Company will move to Sheboygan, Wis., where a new plant will be erected.

The Hartford Suspension Company, Jersey City, N. J., manufacturing auto attachments, will enlarge its plant.

I. Jones, Washburn, Wis., has charge of the building of a large box-crating and wire reel factory at Bayfield, Wis.

The Gibson Mandolin and Guitar Company, Kalamazoo, Mich., will erect a two-story factory and install new machinery.

The United States Furniture Company, of Chicago, Ill., will rebuild the plant at Manitowoc, Wis., recently burned.

Felig Bros. Box Manufacturing Company, of St. Louis, Mo., contemplates establishing a factory at Shreveport, La.

The Burlington (Iowa) Mold and Novelty Company will need machinery for model novelty work and light machine work.

The Reliance Iron and Engine Company, Racine, Wis., is erecting an addition to the foundry and remodeling plant.

The Unigraph Register Company, of Jersey City, N. J., will locate a plant in Millville, N. J., which is to employ 300 people.

The Onward Manufacturing Company, Menasha, Wis., will build a factory for the manufacture of hardware specialties.

The plant of the American Vulcanized Fibre Company, Newark, Del., was partly destroyed by fire. Loss, about $150,000.

The plant of the G. B. Lewis Company, Watertown, Wis., making boxes, beehives, etc., was destroyed by fire. Loss, $80,000.

The American Laundry Machinery Manufacturing Company, Rochester, N. Y., contemplate the erection of a new factory.

Reeves & Co., of Columbus, Ind., will erect a factory at Regina, Saskatchewan, Canada, for the manufacture of steam plows.

The Emerson Steam Pump Company, of Alexandria, Va., has awarded a contract for the erection of a new factory building.

A. Weiskettel & Son, Baltimore, Md., manufacturers of stoves and ironware, will erect two additional buildings at Bayview Junction.

The National Sanitary Manufacturing Company, Salem, Ohio, is building an addition to foundry and making other improvements.

The Jones & Laughlin Steel Company, of Pittsburg, will build a plant at Aliquippa for the manufacture of wire and wire products.

The plant of the Beach & Fuller Company, Evansville, Ind., manufacturing baskets and veneers, was burned. Loss, about $40,000.

Hanlon & Thornton, jewelry manufacturers

of North Attleboro, Mass., have purchased a site in Woonsocket, R. I., where they will locate.

The Lozier Motor Company, Plattsburg, N. Y., is beginning to purchase machinery required, which will involve an expenditure of $25,000.

A three-story addition will be built to the foundry and experimental department of the Rock Island Plow Company, Rock Island, Ill.

The F. B. Stearns Company, Cleveland, Ohio, will erect a four-story addition to its automobile plant to be used as a machinery department.

The Jacob J. Vollrath Manufacturing Company, Sheboygan, Wis., conducting a foundry and enameled ware plant, will make additions.

The Hudson & Manhattan Railroad Company will build machine and repair shops on Henderson street, near 13th street, Jersey City, N. J.

The Kirby Lumber Company, of Houston, Texas, will rebuild a circular and band mill, drykilns, etc., recently burned at Browndel, Texas.

The Hart-Parr Company, Charles City, Iowa, builders of gasolene engines and traction engines, will build a new factory for its traction-engine business.

It is reported that the Jones & Laughlin Steel Company, of Pittsburg, is negotiating for a plant in South Connellsville, Penn., which is to be converted into a brass foundry.

The Nilson Yacht Building Company, Baltimore, Md., whose plant was recently burned, is preparing to rebuild. They will install woodworking and machine-shop equipment.

A new industry for the extraction of tannin from hemlock bark will be erected at Wells, Mich. F. M. Shaw, of Milwaukee, Wis., and F. M. Shaw, Jr., of Medford, Wis., are interested.

The Imbler Fence and Manufacturing Company, Alexandria, Ind., will build an addition to their present plant, doubling size. A complete machine shop equipment will be installed.

The Southern Iron and Steel Company has completed negotiations to remove its wire, rod and nail mill from Ensley, Ala., to Gadsden, where a new plant, to cost $1,000,000, will be erected.

The Wheeling & Lake Erie Railroad Company has awarded a contract for the construction of repair shops at Brewster, Ohio, to cost $750,000. Also $60,000 will be spent on a roundhouse and turntable.

The Electric Steel Company, of Cleveland, Ohio, has purchased a site at Queen Junction, Butler, Penn., and, it is said, will erect a plant to cost $500,000 for the manufacture of steel and machinery.

The New Jersey Dry Dock Company, Elizabeth, N. J., will build an addition to its boat-building and repair plant. Machinery is being purchased for repairing and constructing iron and steel vessels.

The Marshall & Huschart Machinery Company, Cleveland, Ohio, has leased some more land adjoining its present holdings, and, it is said, will erect thereon a manufacturing building to cost about $250,000.

The Isabella-Connellsville Coke Company has let a contract for two concrete shafts at Arensburg, Fayette county. It is the purpose of the company to construct three plants to be equipped with modern machinery.

The Isthmian Canal Commission, Washington, D. C., will receive bids until 10:30 a.m., August 10, for electrical material, including fixtures, fittings, batteries, cable wire, lineman's tools, hardware, mica, soldering material, conduit, etc., as per circular No. 526.

The Wyman & Gordon Company, Worcester, Mass., manufacturing drop forgings, is to erect an addition to forge shop and a new two-story machine building. New equipment will be installed, including hydraulic presses, hammers, upsetting and forging machine, etc.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: August 10—Sheet asbestos (schedule 1502), aneroid barometers, drawing instruments (schedule 1486), chain blocks, check valves (schedule 1495), drills, mandrels, steel tape (schedule 1503), screws, sheet iron (schedule 1502), aluminum, brass rod, sheet copper (schedule 1493), steel (schedules 1503, 1492), gasolene engine (schedule 1482), engine lathes (schedule 1481), emery grinding machines, electric driving centrifugal machines (schedule 1479); August 17—Railroad cars (schedule 1508), filters (schedule 1509), centrifugal machines (schedule 1509).

## New Incorporations

The Monongahela Stone, Clay and Brick Company, Uniontown, Penn., has been incorporated to quarry stone and manufacture brick.

The Waterloo Drop Forge Company, Waterloo, Iowa, has been incorporated. Capital, $100,000. Incorporators, John R. Morris, J. W. Lodwick, etc.

The Campbell Electric Company, Lynn, Mass., has been incorporated to manufacture electric motors. Capital, $20,000. Chas. E. Campbell, president.

The Imperial Motor Car Company, Hamilton, Ohio, has been organized with $500,000 capital by G. A. Rentschler, Geo. H. Helvey, C. N. Carpenter and others.

The Muncie Motor Truck Company, Muncie, Ind., has been incorporated to manufacture motor trucks. Thomas L. and Hugh Warner of Muncie are interested.

The Hattiesburg Blow Pipe and Sheet Metal Works, Hattiesburg, Miss., has been incorporated with $10,000 capital. Incorporators, T. H. Campbell, C. C. Eure, etc.

The Bi-Motor Equipment Company, Boston, Mass., has been incorporated to manufacture motors. Capital, $50,000. President, F. A. Putnam, 22 Lincoln street.

The Lowe-Stephenson Pump Company, St. Louis, Mo., has been incorporated. Capital, $10,000. Incorporators, A. H. Lowe, C. H. Stephenson, G. Stephenson, etc.

The Acme Current Pump Company, Durango, Colo., has been incorporated to manufacture pumps operated by a flow of water. Capital, $50,000. President, John R. Butler.

The Smith-Rolfe Company, Portland, Me., has been incorporated to manufacture and deal in automobiles, etc. Capital, $25,000. John H. Pierce, Portland, president.

The Copley Motor Company, Boston, Mass., has been incorporated to do a general automobile business. Capital, $25,000. J. Edward Lowell, 32 Cambria street, president.

The Cambridge Iron Works, Cambridge, Mass., has been incorporated to conduct a general iron works. Capital, $25,000. President, John C. Dow, 14 Chatham street, Boston.

The Victor Manufacturing Company, Bloomfield, Ind., has been incorporated to manufacture a lifting jack. Capital, $25,000. Directors, I. F. Slinkard, J. A. Phillips, A. D. Slinkard.

The Canister Company, Phillipsburg, N. J., is incorporated with $200,000 capital to manufacture cans, canisters, etc. Incorporators, Chas. G. Woods, R. W. Darnell, J. F. Adams.

The Defiance Screw Machine Products Company, Defiance, Ohio, has been incorporated by William Geiger, John Schragg and others. Automobile metal parts will be manufactured.

The Reed Manufacturing and Box Company, Mound City, Ill., has been incorporated to manufacture wooden articles and boxes. Capital, $15,000. Incorporators, Chas. L. Rice, Henry Reed and others.

The Henderson Engineering and Sales Company, New York, has been incorporated to manufacture foundry machinery. Capital, $100,000. Incorporators, H. Henderson, B. D. Powelson, C. A. Oakes.

The Malleable Equipment Manufacturing Company, Toledo, Ohio, has been incorporated to manufacture malleable iron castings. Capital, $10,000. Incorporators, Wm. Coghlan, E. F. Abbey, D. E. Holland, etc.

The Pittsburg Tack and Nail Company, Newark, N. J., has been incorporated. Capital, $100,000. Incorporators, I. T. Hunter, A. Brice Cane, etc. The company will manufacture tacks, nails and hardware specialties.

D. M. Parry, formerly of the Parry Manufacturing Company, Indianapolis, Ind., is organizing a company to manufacture automobiles and to be known as the Parry Automobile Company. Capital will be $1,000,000.

# Want Advertisements

*Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.*

## Miscellaneous Wants

Caliper list free. E. G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Manufacturers' Capital—Three patents for practical universal use, one a combination tool 5 in 1, for sale or royalty. Zander, 13 E. 11th St., N. Y.

Metal specialties manufactured; models, dies and special machinery. Inventions perfected; correspondence solicited. W. E. Villinger, Williamsport, Pa.

Lathe and machine work of every description, patterns, gear cutting, screw machine work, iron, brass and aluminum castings. The Sipp Electric & Machine Co., Paterson, N. J.

Wanted—To sell or negotiate machine patents, patterns, etc.; big market and good profit; highest possible indorsements; $10,000 to $25,000 backing required. "Builder," 808 N. C. Ave., Washington, D. C.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Manufacturers located in New York, or New England, equipped with facilities to build machinery weighing up to 5000 pounds, mostly lathe and planer work, may be interested by addressing Box 480, AM. MACH.

To correspond with machining contractors having ample capacity and desiring contracts for machining automobile cylinders and pistons in lots 50 to 1000. Either New England or near New York City. "Automobile," Box 451, care AMERICAN MACHINIST.

A large well equipped machine shop on the south side of Chicago would like some work outside of its regular line; factory is equipped to do small and moderately heavy work; also experimental work; has good railroad facilities. Box 428, AMER. MACHINIST.

Mechanical engineer of experience in the operative end of manufacture expects to make two years' study of industrial conditions in France and Germany and will make special investigation on business and technical subjects. Box 477, AMER. MACHINIST.

## Situations Wanted

*Classification indicates present address of advertiser, nothing else.*

FLORIDA

Progressive young foundry foreman is open for engagement; can run both pattern shop and foundry; 16 years in pattern shop, eight of which was foreman; 2 years as foundry foreman casting from 1 to 5000 pounds, 8 to 12 ton heat; at present employed; good reference. Box 472, AMERICAN MACHINIST.

ILLINOIS

Chief draftsman; engines, power plant, mining and general work; shop experience; expert designer; American. Address Box 475, AMERICAN MACHINIST.

Assistant superintendent or master mechanic; mechanical engineer of 19 years' broad, technical, practical experience, solicits correspondence with large firm desiring man having thorough experience in latest tool designing and cost reduction methods; age 37; holding responsible executive position with large electrical works on medium and light work; desire change. Box 483, AMER. MACH.

INDIANA

A natural born mechanic and foreman, A-1 machinist and diemaker, expert on punch presses, successful organizer, also in handling men, at present holding a responsible position with good recommend, open for engagement in two weeks; good foreman position will be accepted; married man, age 29. Address M. N., P. O. Box 61, S. Whitley, Ind.

MASSACHUSETTS

Technical graduate desires to make change. Ten years' experience general mill work, construction work, machine design, shop supervision and charge of general engineering drafting room. References. Address Box 463, AM. MA.

NEW JERSEY

Foreman and assistant superintendent is open for position; machinery, tool and die work, manufacturing, practical, executive; age 34; references; interview. Box 471, AMERICAN MACHINIST.

Thorough office man, 33, seeks change; fifteen years' machine manufacturing experience in both office and shop; now advertising manager; master of all office details; formerly had charge of the order, shipping, billing and correspondence departments; good executive ability, aggressive and successful; moderate salary to start; Middle West preferred. Address Box 469, AMER. MACHINIST.

NEW YORK

Mechanical designer is open for responsible position; nine years' experience; employed, but desires change. Box 482, AM. M.

Designing engineer, high-grade automatic tools and machines; 17 years' experience, practical mechanic; graduate; can show records of successful accomplishments; any locality; $45 per week. Box 478, AM. MACH.

Position as foreman of machine shop or tool room, by an American; age 30; married; 14 years' experience as machinist, toolmaker, draftsman and foreman; technical education; present position foreman of machine shop. Box 473, AMERICAN MACHINIST.

Salesman, age 35, at present representing a machinery manufacturing company in Ohio, acquainted with the mill supply and machinery trade of New York, Pennsylvania and New Jersey. Would like to make connections with a manufacturing concern, or represent a company in New York and vicinity. Have had experience in office and factory work. Reason for changing personal and a desire to stop traveling. Box 470, AMER. MACH.

OHIO

Mechanical engineer, college graduate, is open for superintendency of small or medium size shop, that will grow under good management; salary to start less object; hydraulic, steam, pneumatic and electric machinery. Box 440, AMERICAN MACHINIST.

PENNSYLVANIA

Mechanical draftsman desires position, 10 years' experience on special machinery and machine tools. Rapid detailer; can furnish reference. Box 468, AMERICAN MACHINIST.

WISCONSIN

Mechanical engineer (28), wants responsible position as designer of hydraulic turbines. Box 474, AMERICAN MACHINIST.

## Help Wanted

*Classification indicates present address of advertiser, nothing else.*

COLORADO

An established company about to re-equip and greatly enlarge its plant, desires applications for the following positions: Factory superintendent, capable of taking entire charge of factory doing nothing but fine accurate work, but which must be done at minimum cost; general foreman, assistant to the superintendent; chief draftsman, preferably one with electrical experience; purchasing agent, cost clerk, shipping clerk, foreman for all machine parts departments; foreman for steel pressing department; blacksmith foreman, who has had experience handling high-grade steels; foundry foreman, who can take entire charge of steel and iron foundry, and who understands the business thoroughly; cost estimator, who has had experience in all departments in this line. In sending applications kindly state fully and in detail all your qualifications, your specialties, if you have any, whom you have worked for, as well as whom you are working for now, salary expected, references, and any other information which will help us in judging the merits of your application. The factory is located in one of America's most healthful and best locations and opportunities are limited only by employees' ability. Address Box 481, AMERICAN MACHINIST.

CONNECTICUT

Wanted—A high-class superintendent to take charge of a growing marine gas-engine shop. A thoroughly up-to-date man, familiar with high-speed steels and modern shop practice, including the establishment of costs and all other shop systems. A rigid investigation will be made, but the right man is assured of an exceptional opportunity. Box 479, AMERICAN MACHINIST.

ILLINOIS

Wanted—First-class vise and floor hands; only those accustomed to machine tool work need apply. Write the Ingersoll Milling Machine Co., Rockford, Ill.

Wanted—A young man who is a first-class machinist with a good education, to learn to operate our machines on the road for us, and eventually to work into the position of salesman. Apply, giving full history of experience, stating age and details in full. The Ingersoll Milling Machine Co., Rockford, Ill.

INDIANA

Two experienced foremen for machine and assembling rooms, manufacturing gasolene motors. Give reference, experience and age. Box 262, AMERICAN MACHINIST.

IOWA

Wanted—An instructor in descriptive geometry and drawing, preferably a graduate in mechanical engineering. Salary, $1000 for nine months' work. Address, giving qualifications, references and sample of drawing, William G. Raymond, State University of Iowa, Iowa City, Iowa.

KENTUCKY

Wanted—Capable salesman with experience in tank and tower line; must be well endorsed. State age, business history, references and salary wanted. W. E. Caldwell Co., Louisville, Ky.

MASSACHUSETTS

Wanted—Foreman for small machine shop near Boston; man must be capable of introducing up-to-date methods and use of appliances; familiar with the use of high-speed steel, and a good handler of men. "Boston," AMERICAN MACHINIST.

Wanted—General superintendent. Must be an exceptionally capable and experienced man with successful record, having large mechanical and executive ability. Permanent position in factory, employing 2500 hands. Box 446, AMERICAN MACHINIST.

Wanted—Young man experienced in order and production department work. Must understand drawings, writing material specifications and hustling work through a factory where all kinds of light mechanical devices are made. Give full detail of experience and salary expected and references. "Producer," Box 467, AMERICAN MACHINIST.

MICHIGAN

Wanted—A few first-class toolmakers on small work; good wages and steady employment for competent men. Box 278, AM. MA.

First-class toolmakers, machinists, turret lathe hands, milling machine hands, wanted; some capable of taking charge of departments. Must be A-1 men. Give age, experience, wages, etc. Apply Buick Motor Co., Flint, Michigan.

Wanted—Large automobile manufacturing concern bringing out new model, wants services of several competent tool and jig designers; permanent positions for right men. Give experience, date available and salary expected in replying. Address Box 454, AMER. MACH.

MISSOURI

Wanted—Inspector on close accurate machine work for a large electrical concern in the West. Box 430, AMERICAN MACHINIST.

NEW YORK

Wanted—First-class lathe boring mill and turret lathe men accustomed to accurate work. Kerr Turbine Company, Wellsville, N. Y.

Toolmakers wanted; first-class men experienced on jigs, fixtures and fine gages for close small work. State age, experience in detail, and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—A first-class thread gage maker, one accustomed to work on master gages. Reference as to character and ability required. This position is open in New York City. Address, Box 462, AMERICAN MACHINIST.

Lathe, planer and boring mill hands wanted for night and day shift; no labor troubles; increasing force; applicants must state wages desired, past experience and if employed at present, to receive further consideration. Apply, Ingersoll-Rand Co., Painted Post, N. Y.

Wanted—A production man or speed boss, a man who is capable of running any machine tool in a well organized manufacturing plant, able to accurately establish premium base; one who will not be influenced by his fellow workmen. To such a man we will pay a liberal salary. Box 485, AMER. MACH.

Wanted—Energetic man with experience on credits who can systematically manage office in manufacturing patented staple products selling to electrical jobbers and contractors; one who will back his judgment with investment of a few thousand dollars preferred. Address Box 484, AMER. MACH.

OHIO

Wanted—One machine shop foreman acquainted with piece work. Box 466, AM. MA.

Wanted—First-class toolmakers, machinists and patternmakers. Address Box 116, Cleveland, Ohio.

Wanted—Machinists accustomed to work on Corliss engines and pumping machinery. State age and experience; give references. The Heisler Company, St. Marys, Ohio.

Wanted—Machinists; only good men need apply. Crank, lathe planer, boring mill and bars, radial drill, Jones & Lamson screw machine, toolmakers, floor and vise handles, increasing force; steady work; good wages. Box 457, AMERICAN MACHINIST.

Wanted—Works manager, capable of taking entire charge of plant employing 300 men manufacturing special machinery. Must be thoroughly experienced in drafting-room, foundry, pattern and machine shop practice. Give full details of self and experience. Box 442, AMER. MA.

Men wanted for automobile factory in northwestern Ohio. Applications wanted for future openings. Machinists, assemblers, toolmakers, molders, machine, bench and floor, millwright helpers, testers, punch press hands, painters, upholsterers. Answering by letter please state rate per hour wanted. Address Box 458, AM. MA.

PENNSYLVANIA

Machinists wanted. Lathe, boring mill and floor hands, air compressor work. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—Draftsmen with experience in designing and checking machinery and machine tools. Location, eastern Pennsylvania. Box 447, AMERICAN MACHINIST.

Wanted—An experienced man as foreman of a machine shop employing about ninety men; must have occupied similar position. Applicant will state age, experience and give references. Box 434, AMERICAN MACHINIST.

Mechanical Drawing—An eastern college will have a position open about September 1st for a technical graduate as junior instructor of mechanical drawing., Applicant must state age, education, drawing office experience, with references and salary expected. Box 370, AMERICAN MACHINIST.

Foreman in modern jobbing shop of 20 employes, on dies and making metal specialties. All-round man, systematic and good executive. Man skilled on deep drawn work preferred. Salary to start, $30 weekly. State references and experiences fully. Box 476, AMERICAN MACHINIST.

Wanted—A good live agent in every shop or factory in the U. S. to sell one of the best known preparations for removing grease and grime from the hands without injury to the skin. Absolutely guaranteed. An agent can make from $5.00 to $25.00 over and above his regular salary. This is no fake. Write for free sample and agents' terms. The Klenzola Co., Erie, Pa.

Wanted—A large machine tool manufacturer desires to employ an A-1 designer. Only such as have had experience on high grade work will be considered. To one who is competent, progressive and of good character an excellent opportunity is offered. State experience, salary expected and give references. All applications will be treated confidentially. Box 465, AMERICAN MACHINIST.

Wanted—An assistant to the general superintendent of a manufacturing company employing about 500 men in the building of hydraulic machinery in eastern Pennsylvania. A splendid opening for the right man, as it is the intention of the present superintendent to soon retire. A man under 40, and one well versed in modern machine shop and foundry practice is desired. Address Box 464, AMERICAN MACH.

RHODE ISLAND

Wanted—Experienced grinding wheel salesman to travel in New England, New York and New Jersey. In reply state age, experience, salary expected and references. Box 450, AMERICAN MACHINIST.

WEST VIRGINIA

Wanted—Some first-class mechanics for lathes, planers and assemblers; best wages paid for best men. None but really first-class mechanics need apply. Address Box 158, Wheeling, W. Va.

WISCONSIN

The advertiser needs a man qualified to select and engage skilful machinists and other employees for an automobile factory. The right man can have good remuneration, and if desired, a responsible permanent position. Address "Automobile," AMER. MACHINIST.

# For Sale

For Sale—The leading jobbing pattern shop of Colorado. By J. L. Gard, Denver.

For Sale—Patents on two automatic machines—one for making screws of all kinds, one for small parts of any kind. Machine can be seen in operation at 16 John St., New York, L. & M. Wollstein.

# Alphabetical Index to Advertisers


| | PAGE |
|---|---|
| Abrasive Material Co. | 159 |
| Acme Machinery Co. | 122 |
| Adams Co. | 119 |
| Advance Machinery Co. | 164 |
| Albro-Clem Elevator Co. | 174 |
| Almond Mfg. Co., T. R. | 152 |
| Alteneder & Sons, Theo. | 166 |
| American Emery Wheel Wks. | 158 |
| American Gas Furnace Co. | 149 |
| American Pulley Co. | 143 |
| American School of Correspondence | 140 |
| American Swiss File and Tool Co. | 3d cover |
| American Tinol Co. | 150 |
| American Tool Works Co. | 8 |
| American Tube and Stamping Co. | 191 |
| American Wood Working Machinery Co. | 112 |
| Ames & Co., B. C. | 183 |
| Armstrong-Blum Mfg. Co. | 140 |
| Armstrong Bros. Tool Co. | 113 |
| Automatic Machine Co. | 93 |
| Bailey, E. B. | 152 |
| Baker Bros. | 181 |
| Barnes Co., Wallace | 151 |
| Barnes Co., W. F. & John | 14 |
| Barnett Co., G. & H. | 66 |
| Barrow Co., A. G. | 150 |
| Bath Grinder Co. | 85 |
| Baush Machine Tool Co. | 33 |
| Bay State Stamping Co. | 151 |
| Beaman & Smith Co. | 15 and 152 |
| Beaudry & Co., Inc. | 187 |
| Becker Milling Machine Co. | 23 |
| Bemis & Call Hardware and Tool Co. | 131 |
| Bertsch & Co. | 187 |
| Besly & Co., Chas. H. | 105 |
| Betts Machine Co. | 6 |
| Bignall & Keeler Mfg. Co. | 135 |
| Bilgram Machine Wks. | 174 |
| Billings & Spencer Co. | 129 |
| Birdsboro Steel Foundry and Machine Co. | 128 |
| Blaisdell Machinery Co. | 140 |
| Blanchard Machine Co. | 131 |
| Bliss Co., E. W. | 31 |
| Blount Co., J. G. | 179 |
| Boker & Co., Hermann | 83 |
| Boston Gear Works | 169 |
| Boston Saw and Tool Co. | 178 |
| Bradford Machine Tool Co. | 5 |
| Bradley & Son, C. C. | 130 |
| Bridgeford Machine Tool Wks. | 34 |
| Bristol Co. | 4th cover |
| Brown & Co., R. H. | 153 |
| Brown & Sharpe Mfg. Co., | 96, 97 and 4th cover |
| Brown & Son, Edward | 164 |
| Browning & Co., Victor R. | 142 |
| Brubaker & Bros., W. L. | 178 |
| Buffalo Fdry. & Machine Co. | 154 |
| Bullard Machine Tool Co. | 65 |
| Butterfield & Co. | 154 |
| Caldwell & Son Co., H. W. | 144 |
| Carborundum Co. | 36 |
| Card Mfg. Co., S. W. | 7 |
| Carpenter Tap & Die Co., J. M. | 129 |
| Carter & Hakes Machine Co. | 181 |
| Carver File Co. | 151 |
| Celfor Tool Co. | 131 |
| Chadwick & Trefethen | 140 |
| Chambersburg Engineering Co. | 138 |
| Champion Tool Works Co. | 182 |
| Chicago Flexible Shaft Co. | 146 |
| Chicago House Wrecking Co. | 185 |
| Chicago Machine Tool Co. | 103 |
| Chicago Raw Hide Mfg. Co. | 170 |
| Cincinnati Bickford Tool Co. | 10 |
| Cincinnati Chuck Co. | 153 |
| Cincinnati Electric Tool Co. | 163 |
| Cincinnati Gear Co. | 170 |
| Cincinnati Gear Cutting Machine Co. | 189 |
| Cincinnati Lathe & Tool Co. | 187 |
| Cincinnati Milling Machine Co. | 24 and 25 |
| Cincinnati Planer Co. | 27 |
| Cincinnati Shaper Co. | 189 |
| Clark Cast Steel Cement Co. | 147 |
| Clayton Air Compressor Wks. | 141 |
| Cleveland Auto. Mach. Co. | 18 |
| Cleveland Crane & Engineering Co. | 142 |
| Cleveland Planer Works | 192 |
| Cleveland Stone Co. | 158 |
| Cleveland Twist Drill Co., | 4th cover |
| Cling-Surface Co. | 133 |
| Clough, R. M. | 137 |
| Clum & Atkinson | 150 |
| Coates Clipper Mfg. Co. | 48 |
| Coes Wrench Co. | 42 and 43 |
| Colburn Machine Tool Co. | 35 |
| Consolidated Press and Tool Co. | 118 |
| Cook Co., Asa S. | 154 |
| Crocker-Wheeler Co. | 179 |
| Crosby Steam Gage & Valve Co. | 187 |
| Cullman Wheel Co. | 174 |
| Cumberland Steel Co. | 150 |
| Curtis & Curtis Co. | 140 |
| Cushman Chuck Co. | 152 |
| Cushman Electric Co. | 124 |
| Davis-Bournonville | 150 |
| Davis Machine Co., W. P. | 140 |
| Defiance Machine Wks. | 137 |
| Desmond-Stephan Mfg. Co. | 158 |
| Detrick & Harvey Mach. Co. | 140 |
| Diamond Chain & Mfg. Co. | 126 |
| Diamond Machine Co. | 49 |
| Diamond Saw and Stamping Works | 135 |
| Dickinson, Thos. L. | 66 |
| Dill Slotter People | 154 |
| Dixon Crucible Co., Jos. | 132 |
| Dreses Machine Tool Co. | 9 |
| Drucklieb, C. | 140 |
| Earle Gear & Mach. Co. | 174 |
| Eastern Machinery Co. | 142 |
| Electric Welding Products Co. | 148 |
| Electro Dynamic Co. | 164 |
| Elgin Tool Works | 138 |
| Elmes Engineering Works, Chas. F. | 134 |
| Emmert Mfg. Co. | 166 |
| Errington, F. A. | 153 |
| Estep & Dolan | 178 |
| Evans Friction Cone | 144 |
| Excelsior Needle Co. | 175 |
| Farrel Fdry. & Mach. Co. | 173 |
| Fawcus Machine Co. | 174 |
| Fay & Scott | 66 |
| Fay Machine Tool Co. | 39 |
| Fellows Gear Shaper Co. | 32 |
| Felton, Sibley & Co. | 129 |
| Ferracute Machine Co. | 134 |
| Firth-Sterling Steel Co. | 110 |
| Fitchburg Machine Works | 139 |
| Flather Mfg. Co., E. J. | 173 |
| Flather Planer Co., Mark | 121 |
| Foote Bros. Gear and Machine Co. | 172 |
| Foote-Burt Co. | 123 |
| Fort Wayne Electric Wks. | 162 |
| Fortuna Machine Co. | 161 |
| Fosdick Machine Tool Co. | 16 |
| Foster Machine Co. | 116 |
| Franklin Mfg. Co. | 149 |
| Gang Co., Wm. E. | 130 |
| Gardner Machine Co. | 158 |
| Garwood Electric Co. | 161 |
| Gem Mfg. Co. | 127 |
| General Electric Co. | 160 |
| General Fire Extinguisher Co. | 178 |
| Geometric Tool Co. | 35 |
| Gisholt Machine Co. | 132 |
| Gorton Machine Co., Geo. | 139 |
| Gould & Eberhardt | 98 |
| Graham Mfg. Co. | 154 |
| Grant Gear Works | 170 |
| Grant Mfg. & Mach. Co. | 125 |
| Graton & Knight Mfg. Co. | 188 |
| Gray Co., G. A. | 28 |
| Greaves, Klusman & Co. | 139 |
| Greene, Tweed & Co. | 114 |
| Gronkvist Drill Chuck Co., | 130 and 153 |
| Hammacher, Schlemmer & Co. | 79 |
| Hardinge Bros. | 182 |
| Harrington, Son & Co., Edw. | 145 |
| Hart & Cooley Co. | 132 |
| Hart Mfg. Co. | 128 |
| Heald Machine Co. | 159 |
| Hendey Machine Co. | 81 |
| Henry & Wright Mfg. Co. | 177 |
| Hess-Bright Mfg. Co. | 178 |
| Highland Park College | 166 |
| Hisey-Wolf Machine Co. | 40 |
| Hoefer Mfg. Co. | 177 |
| Hoggson & Pettis Mfg. Co. | 153 |
| Horsburgh & Scott Co. | 169 |
| Hoskins Mfg. Co. | 150 |
| Howson & Howson | 166 |
| Huribut-Rogers Machine Co. | 120 |
| Huther Bros. Saw Mfg. Co. | 138 |
| Hyatt Roller Bearing Co. | 145 |
| Independent Pneumatic Tool Co. | 141 |
| Industrial Oxygen Co. | 147 |
| Ingersoll Milling Machine Co. | 37 |
| Ingersoll-Rand Co. | 141 |
| International Acheson Graphite Co. | 131 |
| International Correspondence Schools | 133 |
| Jacobs Mfg. Co. | 153 |
| Jefferson Union Co. | 133 |
| Johnson Machine Co., Carlyle | 134 |
| Jones & Lamson Mach. Co., | 12, 13 and 66 |
| Juengst & Son, Geo. | 128 |
| Kearney & Trecker Co. | 26 |
| Kelly Co., R. A. | 137 |
| Kempsmith Mfg. Co. | 22 |
| Knight Machinery Co., W. B. | 187 |
| Kern Machine Tool Co. | 107 |
| Keuffel & Esser Co. | 167 |
| Kolesch & Co. | 166 |
| L. & D. Co. | 144 |
| Landis Machine Co. | 138 |
| Landis Tool Co. | 75 |
| Lang Co., G. R. | 178 |
| Lapointe Machine Tool Co. | 187 |
| Lea Equipment Co. | 138 |
| LeBlond Machine Tool Co., R. K. | 81, 168 and 4th cover |
| Lincoln-Williams Twist Drill Co. | 38 |
| Link-Belt Co. | 109 |
| Lodge & Shipley Machine Tool Co. | 4 |
| Long & Allstatter Co. | 137 |
| Lucas Machine Tool Co. | 39 |
| Lufkin Rule Co. | 166 |
| Lumen Bearing Co. | 150 |
| Lynn Tool Forging Co. | 155 |
| Lyon Metallic Mfg. Co. | 137 |
| Manning, Maxwell & Moore, Inc. | 191 |
| Manufacturing Equipment and Engineering Co. | 132 |
| Manville Bros. Co. | 178 |
| Manville Machine Co., E. J. | 181 |
| Maris Bros. | 142 |
| Marshall & Huschart Mch. Co. | 185 |
| Marston & Co., J. M. | 140 |
| Massachusetts Saw Works | 138 |
| McCabe, J. J. | 41 and 184 |
| McCabe Machine Co. | 186 |
| McGraw-Hill Book Co. | 104 |
| Mechanics Machine Co. | 139 |
| Merrill Mfg. Co. | 136 |
| Merritt, Jos. | 66 |
| Meyer Reamer Co. | 136 |
| Millers Falls Co. | 151 |
| Milton & Son, S. G. | 145 |
| Milwaukee Correspondence Schools | 136 |
| Mitts & Merrill | 117 |
| Modern Machinery Co. | 140 |
| Modern Tool Co. | 156 |
| Moline Tool Co. | 180 |
| Moore & White Co. | 142 |
| Morgan Construction Co. | 174 |
| Morris Fdry. Co., John B. | 180 |
| Morse Chain Co. | 127 |
| Morse Twist Drill and Mach. Co. | 77 |
| Morse, Williams & Co. | 172 |
| Morton Mfg. Co. | 98 |
| Mossberg Wrench Co. | 147 |
| Motch & Merryweather Machinery Co. | 184 |
| Mueller Machine Tool Co. | 137 |
| Mummert, Wolf & Dixon Co. | 158 |
| Mutual Machine Co. | 140 |
| National-Acme Mfg. Co. | 192 |
| National File and Tool Co. | 175 |
| National Machine Co. | 139 |
| National Machinery Co. | 1 |
| New Britain Machine Co. | 183 |
| New England Gear Works | 174 |
| New Haven Mfg. Co. | 118 |
| New Process Raw Hide Co. | 171 |
| Newark Gear Cutting and Machine Co. | 173 |
| Newton Machine Tool Wks. | 11 |
| Niagara Machine Tool Co. | 183 |
| Nicholson & Co., W. H. | 50 |
| Nicholson File Co. | 17 |
| Niles-Bement-Pond Co., | 2 and 51 to 58 and 185 |
| Northern Engineering Wks. | 142 |
| Norton Co. | 95 |
| Norton Grinding Co. | 94 |
| Nuttall Co., R. D. | 170 |
| Obermayer Co., S. | 150 |
| Oesterlein Machine Co. | 156 |
| O. K. Tool Holder Co. | 140 |
| Osgood, J. L. | 138 |
| Owen Machine Tool Co. | 22 |
| Page-Storms Drop Forge Co. | 151 |
| Parker, C. L. | 166 |
| Parker Co., Chas. | 154 |
| Parker White Metal and Machine Co. | 150 |
| Patterson, Gottfried & Hunter | 182 |
| Pawling & Harnischfeger | 142 |
| Paxson Co., J. W. | 141 |
| Pearce Co., Fred'k | 182 |
| Philadelphia Gear Works | 170 |
| Philips Pressed Steel Pulley Works | 144 |
| Phosphor Bronze Smelting Co. | 148 |
| Plunket, J. E. | 154 |
| Potter & Johnston Mach. Co., | 20 and 21 |
| Powell Co., Wm. | 140 |
| Pratt & Whitney Co., | 3 and 59 to 64 |
| Pratt Chuck Co. | 153 |
| Prentice & Co., Inc., Geo. G. | 44 |
| Prentice Bros. Co. | 29 |
| Prentiss Tool & Supply Co. | 184 |
| Prentiss Vise Co. | 154 |
| Quride Co. | 172 |
| Ransom Mfg. Co. | 158 |
| Ready Tool Co. | 120 |
| Reed Co., F. E. | 87 |
| Reed Mfg. Co. | 154 |
| Reeves Pulley Co. | 142 |
| Risdon Tool Works | 136 |
| Rivett Lathe Mfg. Co. | 3d cover |
| Robbins Machine Co. | 183 |
| Robinson Tool Works | 138 |
| Rockford Drilling Mach. Co. | 47 |
| Rockwell Furnace Co. | 150 |
| Rockwood Mfg. Co. | 142 |
| Rogers & Hubbard Co. | 150 |
| Root Co., C. J. | 140 |
| Roth Bros. & Co. | 164 |
| Rowbottom Machine Co. | 158 |
| Royersford Fdry. and Mach. Co. | 136 |
| Safety Emery Wheel Co. | 157 |
| St. Louis Machine Tool Co. | 183 |
| Sames, C. M. | 166 |
| Sanford Mfg. Co., F. C. | 149 |
| Saunders Sons, D. | 136 |
| Sawyer Gear Works | 170 |
| Sawyer Tool Mfg. Co. | 166 |
| Schaeffer Machine Wks. | 186 |
| Schellenbach-Hunt Tool Co. | 151 |
| Schieren Co., Chas. A. | 111 |
| Schuchardt & Schutte | 99 |
| Schumacher & Boye | 9 |
| Schwerdtle Stamp Co. | 186 |
| Sebastian Lathe Co. | 37 |
| Sellers & Co., Inc., Wm. | 30 |

# The Machine Has Taken Away the Job

## How the Horse-drawn Vehicle Is Being Rapidly Put out of Business in All City Work by the Automobile. The Dollars and the People in It

SPECIAL CORRESPONDENCE

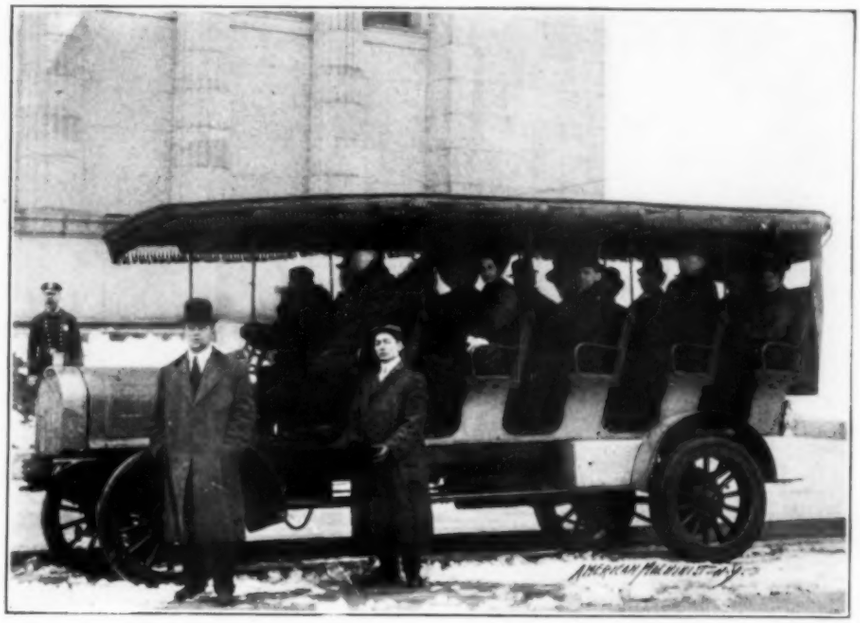
The public streets are full of machinery and the once fresh air is full of gasolene smoke. Not only is it dangerous to life and limb to cross a city street in the midst of these machines, but the pedestrian of a sensitive nature actually feels ashamed to be merely walking when it seems that all but he are gliding along in automobiles.

Even the old fashioned buggy ride with one's sweetheart is almost a thing of the past due to the imperative "honk" of the six-cylinder car which needs the road and stops not for either grades or curves. The "speed bug" claims more fatalities every Sunday and holiday than any other deadly germ known to science.

### It's Not All for Fun Either

Though amusement is still the main factor in the automobile industry, there are new uses being discovered for the motor-driven vehicle every day. These uses are becoming more and more of a commercial nature. Hardly any large mercantile establishment in the city is without a complete line of automobile trucks. The express companies are using them extensively. The fire departments are rapidly adopting them in place of the horse-drawn hose truck. The police use them for patrol wagons, the hospitals for ambulances and the motor policeman is becoming as important as the horse-mounted guardian of the law, in the parks.

In front of every hotel there will be found a long line of taxicabs waiting for hire and in the public squares there are dozens of machines of all kinds, even up to the 7-passenger touring car, ready to dash off at a moment's notice from a patron. Along this same line there is also the familiar sight-seeing automobile engaged in "personally conducting" large numbers of visitors around the cities.



"PERSONALLY CONDUCTED." THE GRAY CARS, NEW YORK CITY

Aside from the nearly 2000 taxicabs in New York City, there is another public use for automobiles which is welcomed by thousands of persons. This is the automobile omnibus which traverses some of New York's busy streets where there are no trolley cars. In fact, although New York is said to be proud of the fact that it is the only city still using horse cars, a very welcome change would be the substitution of these motor buses for the dilapidated old horse cars left over from

A GROUP OF 77 TAXICABS PUTTING THE HORSE TO SHAME IN NEW YORK CITY

AUTOMOBILE TRAFFIC ON FIFTH AVENUE, NEW YORK CITY

AUTOMOBILES IN LONGACRE SQUARE, VIEW FROM TIMES BUILDING, NEW YORK CITY

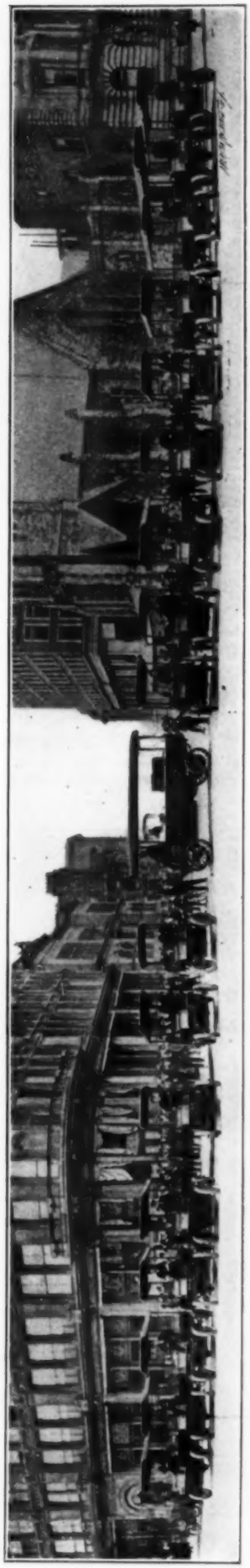
A SUBSTITUTE FOR THE STREET CAR

the days of our grandfathers. This change is undoubtedly one of the near future.

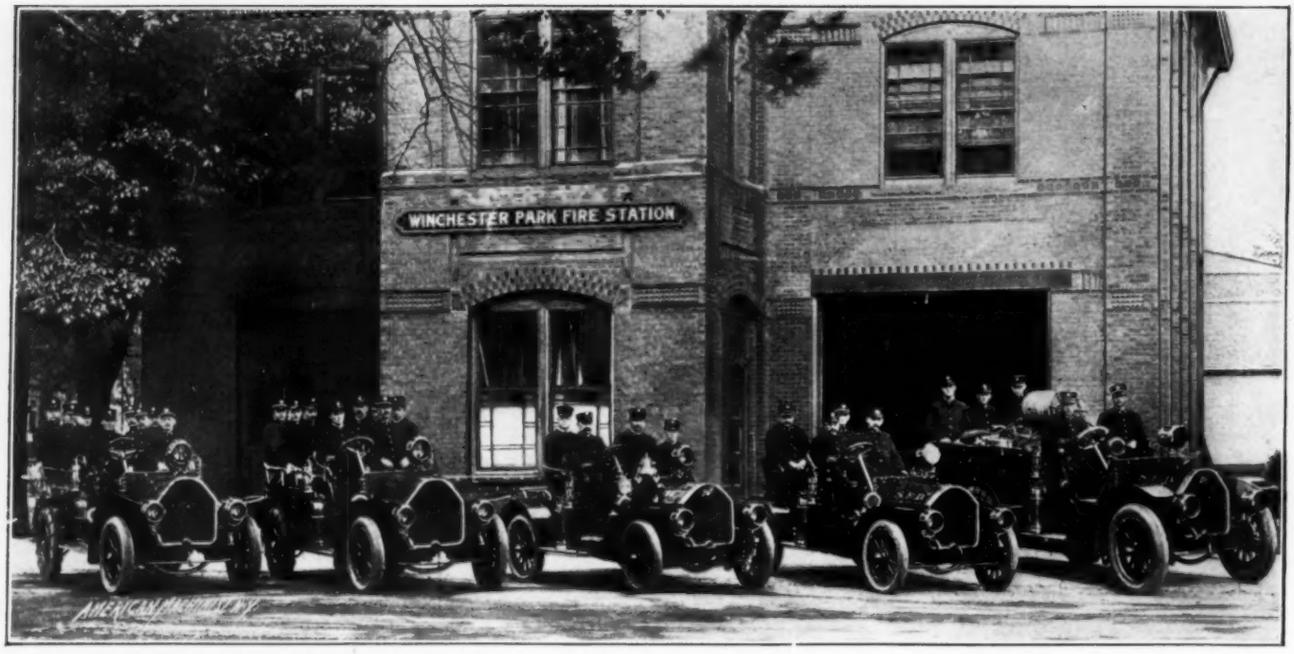
### The Dollars in It

All these things are, of course, very familiar to everyone, but it is hardly realized what an enormous industry the automobile business is, and what a tremendous influence it has had in creating other businesses of allied interest. At the present time there are 253 large automobile factories in the United States. Eleven years ago there were only 25. Ten years ago, the capital invested in the automobile business was estimated at $2,000,000. Today this figure is said to be $200,000,000. This includes $36,000,000 in the kindred trades, that is, supplies of

THEATER ADVERTISING AUTOMOBILE



A GROUP OF ADAMS EXPRESS TRUCKS. COURTESY OF B. F. GOODRICH COMPANY, OF NEW YORK



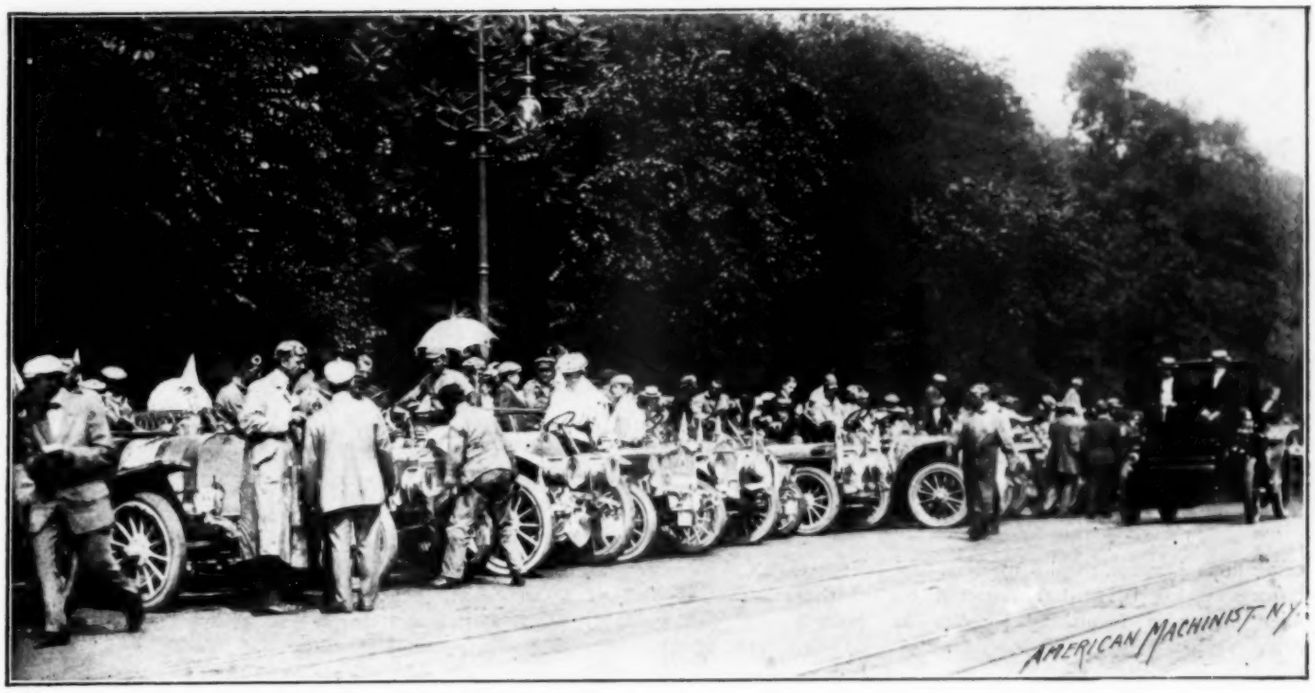

AUTOMOBILE FIRE TRUCK AND BRIGADE. COURTESY OF KNOX AUTOMOBILE COMPANY

all kinds from pneumatic tires and search lamps to buttons for automobile coats. There is estimated to be $57,000,000 invested in garages and their equipment. In fact, the kindred trades brought into life by the automobile are said to number at least 500.

Eleven years ago there were 1200 automobiles in the United States. There are today very close to 175,000 machines in operation. This is twice as many machines as are now in use in the whole of Europe. In New York State alone there are 80,000 cars registered at the present time.

Here is a list of the American output of automobiles measured in dollars in the last six years, as given by the American Motor Car Manufacturers Association: 1903, $16,000,000; 1904, $24,500,000; 1905, $42,000,000; 1906, $59,000,000; 1907, $106,000,000; 1908, $125,000,000. These sound like figures for capitalization in high finance, but, as said, these figures repre-

HIGH-PRESSURE HOSE WAGON. KNOX AUTOMOBILE COMPANY




GLIDDEN TOURISTS ON FIFTY-NINTH STREET, NEW YORK CITY

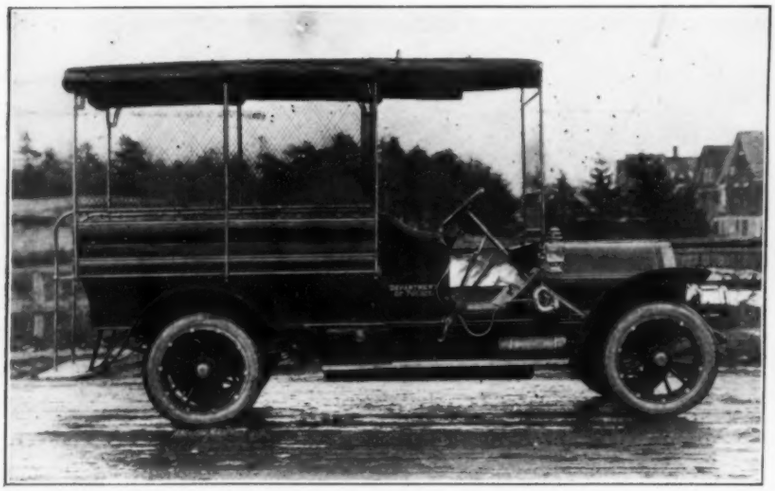
sent the year's output in automobiles in the United States. So much for the dollars.

### The People in It

The automobile factories in the United States are said to employ about 58,000 men. In the making of parts for automobiles there are 29,000 other persons engaged, while in selling machines and accessories and in garages, there are 22,000 other persons employed.

Not only does this mean, simply employment and the investment of money, but a new line of engineering and mechanics has been developed by the automobile, calling for ingenuity of the very highest character. The trade journals of the day are filled with articles describing special tools, special jigs and novel machine operations for the finishing of the many parts of automobiles, which would never have been invented for other classes of machinery. This again has given a

AN AUTOMOBILE PARTY ON "AUTOMOBILE ROW," NEW YORK CITY



A KNOX AUTO POLICE PATROL

AUTO HOSPITAL AMBULANCE

tremendous impetus to the machine-tool business which is further reflected on other industries furnishing supplies to them.

### The Way It Grows

During April and May of 1908 there were registered in New York State alone 3837 new automobiles. During the corresponding period of this year, this new registration grew to 6483 machines. This is a growth of 69 per cent. As in 1908 the total registration showed that there were 13,980 machines running in New York City and assuming that the increase there will be at the same rate at least as for the whole State, that is, 69 per cent. above last year's registration, this would indicate that this year there will be very nearly 24,000 automobiles in operation in New York City only.

One short stretch of Broadway in New York City which was originally not over half a mile long is known as Automobile Row. This stretch is growing every day until automobile sales rooms and sales rooms for tires and other supplies are rapidly running into the residence district of upper Broadway. In this stretch there are now about 125 different stores selling automobiles and sundries, but not including the many garages which are in this district both on Broadway and in the side streets.

### Keeping Tab

One of the dealers in this district having a taste for figures, has made a number of counts of machines passing his establishment between the hours of 2 and 3 on an ordinary afternoon. This

THE MERCANTILE TRUCK. THE UNITED CIGAR STORES COMPANY

count developed the fact that an average of about 725 automobiles passed his door during that hour and that this number was 75 in excess of the number of horse-drawn vehicles passing at the same time. This gives us a chance for a little interesting arithmetic. As already said, last year's output in machines reached the enormous figure of $125,000,000. This represents the selling price of 75,000 automobiles. Dividing $125,000,000 by 75,000 gives an average price of $1666 for each machine. If this price were an average, the 725 cars passing the door on Broadway would represent a value of nearly $1,208,000 passing in one hour.

As in New York City the people seldom or never go to bed, it may be assumed that 500 cars pass that point every hour for at least 12 hours of the day. The time is limited to 12 hours because even though the machines seem to be running all night, these people do have to stop to eat and we must take into consideration at least four hours spent by many of them every night at the theater and the restaurant supper after the theater. This would give us a total of 6000 machines passing our observation point every time the earth turns around once. At the same price of $1666 each this comes to approximately $10,000,000 worth of machinery passing by per day. A similar count on Fifth avenue at Forty-second street would produce probably an even more sensational figure.

A MAXWELL EMERGENCY FIRE PATROL

### When They Hurry

The old boast of one of our most prominent locomotive builders that they could turn out three locomotives a day is now caused to fade into oblivion by the claim of more than one automobile concern that they can turn out one machine complete in all its parts every eight minutes.

Mr. Oliver Herford, in one of his amusing books, makes the statement that the population of the world is composed of approximately 999,000,000 human beings and 1,000,000 chauffeurs. It may be interesting to Mr. Herford to learn that about 10,000 of these chauffeurs are in New York State alone.

### For "Depression"

During the last two years we have heard a great deal about business depression, but, during all this period, there was at least one business which does not seem to have felt any depression at all; that is the automobile business. The stability of the automobile business has been the greatest possible boon to all the other manufacturers and kindred trades which are affected by the automobile, for it was a fact that every concern that made anything that had anything to do with automobiles and sundries was working just as hard as ever and appeared to have absolutely no faith in the "panic" at all. It would indeed be difficult to overestimate the steadying effect of the automobile trade during this time.

The only question to the ordinary mortal is, where did all the money come from to pay for these machines? That, of course, is a problem for the financial experts and the credit man. It may be possible also that the broker in house mortgages knows something about where this money came from. However, to make such a statement lays us open to the charge that we are envious in our disposition. We are. We have no automobile. We are thinking seriously of buying one, however.

## Protractor Attachment for Measuring Angle of File Teeth

By Edwin Herbert

By Fig. 1 is illustrated an instrument that we have recently gotten out to measure the angles of file teeth. It consists of a Brown & Sharpe protractor fitted with a low-power microscope in place of the usual blade. The lens of the microscope has a hair line ruled to cross the center of the field.

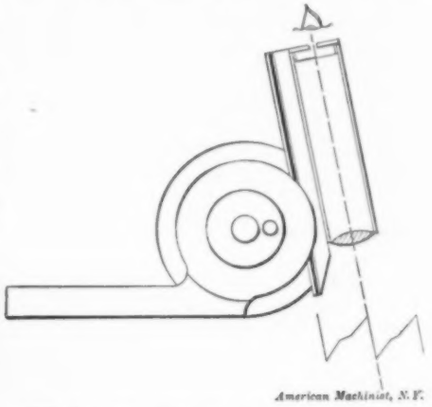



FIG. 2. ARRANGEMENT OF ATTACHMENT

In using the instrument the stock is rested on the face of the file at right angles to the upcut. The microscope is tilted until the line of sight is seen to lie in the plane of the front face of a file tooth, and the angle is then read from the graduations on the protractor.

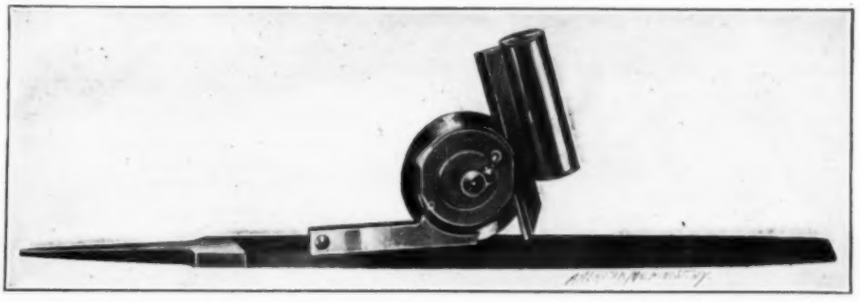


FIG. 1. PROTRACTOR ATTACHMENT FOR MEASURING ANGLES OF FILE TEETH

The diagrammatic view, Fig. 2, shows the setting of the instrument, and in Fig. 1 the microscope is set to a file tooth sloping backward 15 degrees.

---

The cutting power of paper revolving at a high rate of speed will be surprising to those who have not seen such experiments conducted. A circle of good quality stiff paper about eight inches in diameter mounted upon the shaft of a motor rotating at a high rate of speed will cut through cigarbox wood in a fashion that makes the onlookers respect the cutting power of paper for other reasons than having once received a finger cut in carelessly handling wrapping paper.

# Machine Control and Levers

By Clevelander

An engraving of a device that I find in *Fer et Acier*, a technical magazine that comes all the way from Belgium, reminds me of the persistency with which an old idea breaks loose anew. It is really nothing more nor less than the attempt to do with one handle what is ordinarily done with several. From the time of the first man who set down his admiration for those making two blades of grass grow where only one had grown before, there have been equal attempts at that delusive simplicity that tries to make one lever do the work of two.

I call it a delusion. There must be something wrong with it even though it is not easy to show where the principle of the thing is awry when it is put into practice.

Not an unattractive scheme is it to have in one lever a widely varied means of manipulating a machine. It appears so slick and simple a proposition that it really ought to catch on and win out by sheer strength of common sense appeal.

### Lathe Wheels and Handles Control Single Movements

Take a lathe, for example. It is one of the commonest of shop tools. The general arrangement of its elements has taken on a sort of standardization or settling into shape that means, if it means anything at all, that the various designers have shed a lot of their variability and the flow of ideas, while not frozen up at all, has nevertheless some indications of crystallization into definite form along certain lines. So as a standard tool of fairly settled style, the lathe may be used as a specimen to illustrate the designer's attitude toward the levers of a machine tool and the tendency of his thought.

The noticeable fact is that as far as my acquaintance goes the trend of the designer is not to combine several operations within the scope of one hand wheel or crank handle but to have a separate element of action for each move of the machine.

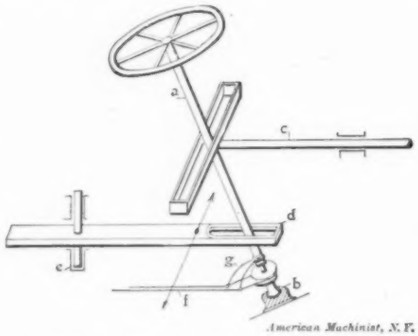
He compels the lathe man to set up his tailstock by first cranking it along the bed with one handle and then it is clamped in position with one or more through bolts if he does not depend wholly on pawl and ratchet for grip. Next he turns the hand wheel and thus extends the center into the work and lastly he clamps it securely by the aid of still another lever. It would not seem practicable to attempt all these tailstock operations by the use of any one means of manipulation. Perhaps that is possible but it looks out of the question. There is, however, no valid reason that I can see to prevent the designer coupling the operations by pairs if he really wanted to make a lathe that way. He might employ a hand wheel having both rotating and sliding movements, the one independent of the other. Then the rotation could advance or return a screw and the other operation would lock it wherever the operator might choose.

Similarly with the movement of the lathe carriage, one could move the tool to the work and then without loosening the grip on the hand wheel push it in or pull it out to engage with the power feed.

All this is so obvious in possibilities of application to machinery that the only explanation of its lack of favor is that the plan as regards the practice thereof must be punk.

### Development of Automobile Control

The application of the one controlling lever or the many is interestingly shown in the progress of automobile design. The multiple-operation handle used by Whitney, Stanley, Mason, and doubtless others of the earlier builders of steam cars—say a dozen years ago—was paralleled by a leading gasolene machine of the same




Machine control and levers steering device for an aëroplane

date. These handles were described in the American Machinist at the time and little need now be said about them save only to point out for the benefit of the later readers of your journal that the one lever performed several functions. By swinging it to the right or left, by raising or lowering, moving it in or out, or by rotating the hand clockwise or counterclockwise, the steering, the speed, etc., could be controlled at pleasure.

"Would not there be some chance for the wrong move to be made," was asked, the lever not indicating by position the condition of the mechanism as perhaps would be shown when having a lever for every item of control.

"No, indeed," said the inventor, "you get so accustomed to it that it works like your arm and with no more thought."

True it was that in his hands—or rather, hand—it worked like a charm. But its vogue has not flourished, ingenious though it unquestionably was in every one of these early efforts that I had a chance to investigate. It is not always the mechanism that shows up well with the inventor that survives the acid test of general use. Today automobiles have commonly come to the individual lever for each item in the controlling mechanism and there must be good cause for this tendency.

### Beginning of Airship Control

Comes now our brother mechanic from abroad with his invention for controlling the three governing functions of an aëroplane. He intends to regulate the equilibrium of the machine, longitudinally and transversely, and the direction by means of a steering wheel similar to that of an automobile. All he exhibits is the part under the hand of the operator and we may reasonably assume that is all he claims. The steering wheel is at one end of a shaft *a* supported by a spherical bearing in a foot step *b*. By pushing the shaft *a* back and forth or from right to left, the rod *c* can be made to slide through its bearings or the lever *d* to turn on its pivot at *e*. The post *a* passes through slotted ends of the elements *c* and *d* and these are so contrived that either may be moved independently, or by suitable manipulation both can be to some degree controlled simultaneously. Rotating the steering wheel also enables the operator to pull one or the other of the cords or wires at *f*. The guides at *g* maintain the cords on the grooved pulley, no matter what the position of the steering-wheel post may be. Thus they are evidently retained by a sleeve which loosely fits the post *a*.

Evidently the aëroplane is to go the way of the automobile and the other pioneering work of the machine industries.

The condensation of many items into one casting or one lever may be as highly ingenious as it is absurdly unnecessary. At one of the international expositions there was a splendid piece of work in a marine engine, bedplate, several cylinders, a pump or two, all in one hunk of cast iron. As a core making and molding example it was as excellent as its design was abominable for anything else. Of course, it was only shown as a foundry exhibit and here it was as much a success as are the cup, saucer and spoon trials that take hold of most molders in their early practice among the kinks and wrinkles set before them by older workmen as stunts the skilful must accomplish.

The separate levers fit the average man more closely than the multiple one. So at least it seems to me. Upon no other ground have I been able to explain to myself the abiding popularity of the one matured plan and the first attractive approach of the other. The distance at which the independent levers must be, the variation in their angles, become associated in the mind with the movements necessary to properly operate them and thus the memory is stimulated to advise the performance of the appropriate act. Hence the body is prompted, as soon as the hands rest on the wheels and levers, to do the right thing in the best way with the various handles.

# Machine-cut Double-helical Gears

## Two Methods of Cutting Are Used—End Milling and Hobbing—The Gears Have Important Advantages but Are Little Known in America

BY PERRY C. DAY

Many able contributors to this journal have dealt with the subject of machine-cut gearing, and there would remain but little more to be said if I proposed to discuss the theme from generally accepted points of view. It happens, however, that very little information has been given touching the remarkable developments, during recent years, of precision methods as applied to the manufacture of double-helical gears. If one can form an accurate opinion from the advertising columns of current technical publications, progress in this direction has been confined to Great Britain and the European continent.

The theoretical advantages of the double-helical type of gear have been well known for many years, but practical difficulties of production have hindered development. Molded double-helical wheels, though extensively used for heavy work where strength has been the prime consideration, are not sufficiently accurate to hold their own against straight-cut spur gearing for high-speed work.

Double-helical wheels are now regularly cut with the same accuracy as the best spurs, and as a consequence the range of application for gearing has been enlarged far beyond the limits of what was considered practicable a few years ago.

Probably the oldest method of producing machine-cut, double-helical wheels is

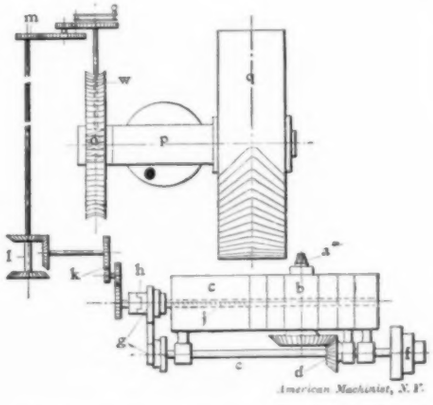



FIG. 1. DIAGRAM OF MILLING PROCESS OF CUTTING DOUBLE-HELICAL GEARS

by using two single-helical wheels of opposite hand, which are bolted together. Each single-helical wheel is usually cut on an ordinary universal milling machine by a cutter the same as, or similar to, those used for straight-toothed gears. The axis of the wheel is set in relation to the plane of the cutter at an angle corresponding to that of the spiral to be cut.

The inaccuracies of this process are many, and are well known to all gear manufacturers. It is practically impossible to determine the correct shape of the cutter for any particular wheel because, in the first place, the contour of the tooth as formed only approximates to the cutter form on the normal section. What is required is the correct shape of tooth on the section normal to the wheel axis, which is the same as for straight-toothed gears. It is exceedingly difficult to find the correct form of cutter which, when cutting its own shape in a spiral groove, will leave a tooth of the desired contour on a section in the plane of rotation of the wheel. This difficulty is, moreover, complicated by the fact that a plane disk cutter does not leave its own shape in a spiral groove, so that even the correct normal-tooth section is practically unobtainable.

Single-helical gears are now cut by a

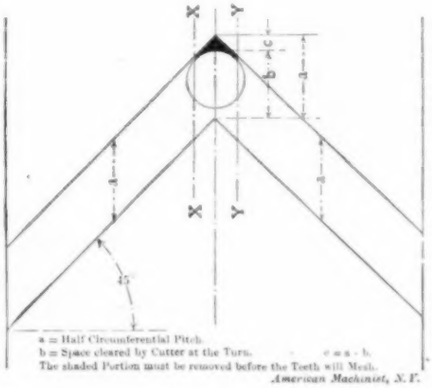

a = Half Circumferential Pitch.
b = Space cleared by Cutter at the Turn.
The shaded Portion must be removed before the Teeth will Mesh.
American Machinist, N.Y.

FIG. 2. DIAGRAM OF SPACE NOT CUT BY MILLING PROCESS OF CUTTING DOUBLE-HELICAL GEARS

generating process using a hob as a cutter. The hob is usually set at an angle in order to make the threads correspond, on the cutting side, with the inclination of the spiral teeth. Although this process is a decided improvement on the first, it has certain inherent defects. In hobbing systems of gear generation the teeth of all wheels are developed from the parent rack. Axial sections of the hob teeth are considered theoretically to correspond with this rack. When the hob is set at an angle other than a right angle in relation to the axis of the wheel blank, the generating section is no longer an axial section, and the tooth form may differ considerably from the involute.

Built-up double-helical wheels can only be used when the pinions are of sufficient diameter to allow of secure fastening; this fact and the expense of production have prevented the type from being used to any large extent. Double-helical wheels are now cut, for the most part, from solid blanks. There are two systems in vogue which have been developed independently, the one is milling, the other a hobbing process.

### Milling Process for Cutting Double-helical Gears

In the milling process the teeth are cut by means of end mills formed to the

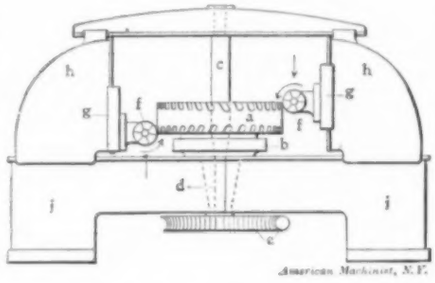



FIG. 3. DIAGRAM OF HOBBING PROCESS FOR CUTTING DOUBLE-HELICAL GEARS

tooth shape on the normal section. The working principle of the machines usually employed is shown in the diagram, Fig. 1. The end mill *a* is supported by the saddle *b*, which traverses the bed *c*. The mill is driven by the bevel gears *d* from the splined shaft *e* and driving cone *f*. The feed and differential motions are driven from *e* through speed cones or gears *g* and clutch *h*. The traverse of the saddle *b* is actuated by the feed screw *j*. Motion is also transmitted from *j* through change wheels *k*, reversing gears *l*, dividing change wheels *m*, worm *o*, dividing wheel *w* and work spindle *p* to the blank *q*.

While the end mill traverses from one edge of the blank to its center, the blank is rotated through an angle which gives the requisite spiral form to the tooth. The saddle then operates a stop which is in connection with the reversing gear *l* and the rotation of the blank is reversed until the end of the cut. A quick-return mechanism, not shown in the diagram, comes into action at the end of the cut, and the mill is returned to the starting position. The dividing mechanism *m* is then operated by hand, and the cutting process is repeated on another tooth.

The end-milling process can be readily

adapted for cutting double-helical bevel gears, and in this respect it holds an advantage over other systems.

The disadvantages of the process are principally of a practical nature. End mills are small tools, and are liable to rapid wear. Since the teeth are cut singly, any wear on the mill causes a change of tooth shape and thickness. The reversal of the angular motion of the blank while cutting proceeds, allows the inevitable blacklash in the mechanism to take effect in a manner which is not conducive to accurate work. The cutter must be formed to the normal tooth section, and has not the circumferential shape of the teeth which it cuts. The width of the tooth space at the apex corresponds to the normal instead of to the circumferential pitch, hence the space must be cleared out by hand or in a separate operation, see Fig. 2.

The tendency to wear is greater when the end mills are small, and wheels on this system are generally made of coarser pitch than is really necessary or even desirable from the user's point of view, in order to minimize the manufacturing difficulties by the use of large mills.

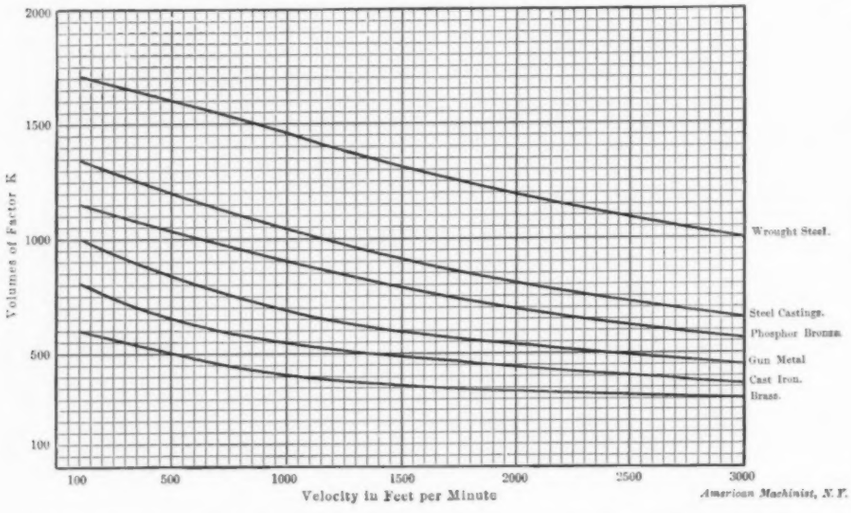



FIG. 4. RELATION BETWEEN VELOCITY AND FACTOR K FOR DOUBLE-HELICAL GEARS

### Hobbing Process for Cutting Double-helical Gears

The latest method of producing double-helical wheels is an adaptation of the hobbing process. A double-hobbing machine of special design is employed, so that the right- and left-hand teeth are cut simultaneously. The working principle of the machine is shown in Fig. 3.

The blank *a* is mounted on the vertical mandrel *c*, and is driven by the faceplate *b* from the work spindle *d* and the dividing worm wheel and worm *e*. The hobs *f f* are mounted in vertical slides *g g*, which move up and down on the standards *h h*. The standards are mounted to slide on the bed of the machine *j* and are provided with micrometer feed screws for adjusting the depth of cut.

The hobs are rotated in the direction shown by the curved arrows, and the dividing wheel *e* is driven at the correct relative speed by means of change wheels. The hob threads are right- and left-hand, and the slides *g g* are fed down and up simultaneously.

In connection with the feed mechanism there is a second train of change wheels which operates a differential gear for correcting the speed of the blank, to give the required spiral lead to the teeth. The process is entirely automatic from the first setting to the completion of a cut all round the wheel.

The teeth of wheels cut on this system are of the staggered or herringbone type, a tooth on one side of the rim being coincident with a space on the other side. This arrangement allows the cutters to clear at the center of the rim, and, incidentally, has the effect of halving the pitch without reducing the strength of the teeth.

This method of producing double-helical wheels has the great advantage that a complete interchangeable system for any pitch is produced from a single pair of hobs. The teeth of all wheels are cut at the same angle, usually 23 degrees. The hobs are constructed with a definite relationship between lead and pitch diameter, so as to give the threads the same angle as the wheels to be cut. As a consequence there is no need to incline the hob axes, which are set at right angles to the axis of the wheel blank.

Axial sections of the hob teeth are of the same form as the parent rack, so that the cutting is done by a true generating process. The pressure angle may conveniently be 20 degrees, and the teeth are usually shorter than the Brown & Sharpe standard, the hight of addendum is

$$\frac{0.89\ p}{\pi}.$$

Since the wheel blank revolves continuously during the whole process of cutting, all errors of division are reduced to an absolute minimum, and the teeth must all be of the same form. To avoid undercutting in small pinions, the pitch circle diameters of all under 20 teeth are enlarged to the formula

$$d = \left\{(0.95 \times No.\ of\ teeth) + 1\right\} \frac{pitch}{\pi}$$

for 20 degrees pressure angle and 0.89 addendum.

In engineering it may be fairly said that old traditions die hard. New principles are accepted with the greatest reserve, notwithstanding the apparent rapidity of modern progress. Certain specialized industries have developed with remarkable speed, but these have for the most part originated within the last two decades,

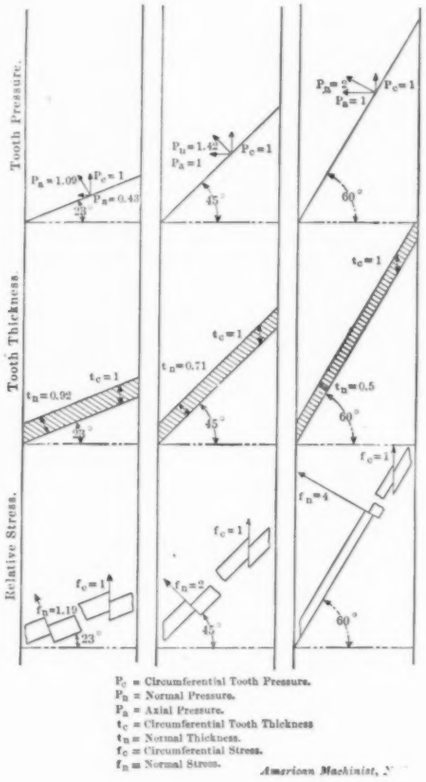

Tooth Pressure.
Tooth Thickness.
Relative Stress.
$P_n = 1.09$ $P_c = 1$ $P_a = 0.43$ 23°
$P_n = 1.41$ $P_c = 1$ $P_a = 1$ 45°
$P_n = 2$ $P_c = 1$ $P_a = 1$ 60°
$t_n = 0.92$ $t_c = 1$ 23°
$t_n = 0.71$ $t_c = 1$ 45°
$t_n = 0.5$ $t_c = 1$ 60°
$f_n = 1.15$ $f_c = 1$ 23°
$f_n = 2$ $f_c = 1$ 45°
$f_n = 4$ $f_c = 1$ 60°
$P_c$ = Circumferential Tooth Pressure.
$P_n$ = Normal Pressure.
$P_a$ = Axial Pressure.
$t_c$ = Circumferential Tooth Thickness
$t_n$ = Normal Thickness.
$f_c$ = Circumferential Stress.
$f_n$ = Normal Stress.
American Machinist, N.Y.

FIG. 5. COMPARISON OF TOOTH PRESSURE, THICKNESS AND RELATIVE STRESS FOR THE TOOTH ANGLES OF DOUBLE-HELICAL GEARS

and have not been stifled under an accumulation of ideas and data which, although they may have been well adapted to the methods of their day, have little usefulness when applied to modern conditions. No branch of engineering industry suffers more from established tradition than that which deals with the mechanical transmission and transformation of power.

### General Conditions Surrounding the Use of Gears

Passing over the early types of spur gearing in which the teeth were, for the most part, carved from hardwood blocks, we come to the type with molded teeth. It

is on this type of gear that most of the textbook data find their basis. Now the molded gear is a different thing to the accurately formed spur wheels which it is possible to produce with the aid of modern tools, and the old rules for calculation are of very little use when applied to the latter. The main consideration used to be the strength of the teeth. This was reasonable at a time when variations in tooth form and spacing made it necessary to reckon with heavy shocks which arose from uneven bearing and engagement of the teeth.

The conditions are entirely different for gears which are accurately cut and mounted. The designer of modern gearing is well advised to give first consideration to the provision of the necessary wearing surface. If this point is properly attended to, and if the tooth shape and pitch are chosen so as to give an even velocity ratio for all positions of the mating teeth, it will generally follow that the requirements of strength are more than satisfied. In the case of straight-cut wheels it is not safe to carry this system of design too far, because the engagement of the teeth is variable. If pinions are used in which the number of teeth is small, the engagement is intermittent. The effect of variable and intermittent engagement of the teeth is to set up vibration and hammer action, which must be taken into consideration when deciding the pitch. Unpleasant noise is produced from the same causes when straight-cut gears are run at the high peripheral speeds which are necessary in many instances, particularly when both wheel and pinion are of metal. The method usually adopted for reducing noise by making the pinion of soft material constitutes a compromise which is totally wrong from an engineering point of view. The pinion teeth, which are in action with the greater frequency, should naturally be of the harder material in the combination, otherwise the pinion must wear out more rapidly than the wheel. Wherever rawhide or other soft material is used for pinions, the proportions must be chosen to suit such material, and it is not surprising that under such circumstances diameters are large and velocities high. It must be further stated that such methods of reducing noise do not eliminate vibration, while anything in the nature of a heavy drive usually fails through rapid wear of the pinion.

### Advantages of the Double-helical System

The adoption of the double-helical principle in gearing, if properly applied, reduces noise to a minimum and practically eliminates vibration without any necessity for departure from sound mechanical principles. In this type of gear, pinions may be chosen of sufficient hardness to wear evenly with the wheels, and soft materials do not enter the proposition. This is due to the absolute continuity of engagement which is characteristic of double-helical gears when accurately cut and correctly designed to suit the working conditions. The effect of vibration is not by any means confined to the gears themselves, but acts injuriously on the shafts and machinery connected therewith. Many failures of haulage and other gear-driven shafts have been directly traced to this cause.

Consider a pair of wheels transmitting 100 horsepower with an efficiency of 96 per cent. If we assume only one-tenth of the lost energy to be dissipated in vibration which is absorbed in the wheel shaft, the result is somewhat surprising. Under such conditions the shaft is called upon to absorb energy at the rate of nearly eight million foot pounds during each working day of 10 hours duration. The result is finally expressed in crystallization of the shaft material.

Accurately cut double-helical wheels have a higher efficiency than straight spurs of equal perfection, particularly when the number of teeth in the pinions is small. The reason is to be found in the different action of the teeth during engagement. True rolling action, with uniform velocity ratio, only occurs during that portion of the engagement which takes place near the pitch line. When the teeth are engaged near the ends, there must always be some sliding at the line of contact. The line of contact in straight-cut spurs lies always parallel to the axis of rotation, and at any instant while a tooth is in action the engagement is the same throughout the length of that tooth. It follows that in the case of a small pinion, where only one tooth bears at a time, the line of engagement varies between extreme positions. The action of the teeth constantly alternates between rolling and sliding motion, with some variations in velocity ratio which, though small in themselves, are nevertheless sufficient to set up considerable vibration and hammer action at high speeds.

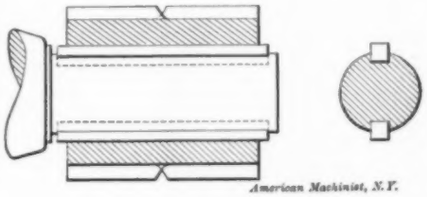



FIG. 6. AN IMPROVED METHOD OF KEYING FOR GEARS

With double-helical gears the contact line is a curve across the tooth from top to bottom, and all phases of engagement take place at the same time instead of consecutively. Those portions of the tooth which, at any instant, are engaged near the pitch line, effectually control and damp out any irregularities of motion which would otherwise be produced by the portions which are in rubbing contact, so that the resultant motion is uniform and vibration does not occur. It will also be seen that while the whole pressure of the load is carried by the teeth of straight-cut pinions when in rubbing contact, in double-helical pinions only a small portion of the load is so carried, the greater part being always borne by portions of the teeth in contact near the pitch line. For the same reason, the maximum bending stress on a straight-cut tooth, which occurs when all the load is carried at the extremity, has no parallel in double-helical gearing. The designer of double-helical wheels is able to leave on one side such considerations as maximum bending moments, vibration and shock factors, and to use simple rules which, although based on the strength of the teeth, are arranged to take into account the pitch-line velocity and ratio of reduction as affecting the wear and life of the gears.

### Design of Staggered-tooth, Double-helical Gears

The following data have been found in practice to give excellent results when applied to the staggered system of double-helical gearing. The basis of calculation is the permissible shearing stress on the pitch line of an imaginary straight tooth right across the face, assuming only one tooth at a time to be in engagement. This permissible stress we will call $K$. To allow for wear at different velocities the values of $K$ are graduated in accordance with the curves shown in Fig. 4.

For ordinary gears with ratios up to 6 to 1 the face width is usually 6 times the pitch. If,

$p$ = Pitch in inches,
$P$ = Tooth pressure in pounds at pitch line,
$w$ = Width of face in inches,
$v$ = Pitch line velocity in feet per minute,
$r$ = Ratio of reduction,

then

$$P = \frac{B.H.P. \times 33{,}000}{v} = \frac{p.w.K.}{2} =$$

$$3\,p^2K \ (if\ w = 6\,p),$$

and

$$p = \sqrt{\frac{P}{3\,K}}$$

In order to give greater proportionate wearing surface to high-ratio gears with small diameter pinions, and to reduce the pitch so that the smallest number of teeth may be consistent with continuity of engagement, the face width is increased with the reduction ratio:

For ratios between 6 and 10 to 1 $w = r\,p$.

For a 10 to 1 gear $w = 10\,p$, and this proportion of face width to pitch is not altered for higher ratios, although wheels of much greater relative width are often used for special purposes. In high-ratio gears the necessary proportions

to insure good wear are provided for by using the following formula:

$$p = \sqrt{\frac{2.5\,P}{r\,K}},$$

with $r = 10$ as a maximum.

The above rules are well suited to all ordinary gear problems. Where moderate shocks have to be met, as for instance in the driving of pumps and air compressors, it is only necessary to calculate the tooth pressure on the mean between the average and maximum turning effort.

In the case of machine tools driven from variable-speed motors, the value of $K$ can be increased three- or four-fold, reckoning on the full power at the lowest motor speed. This is because the normal values of $K$ in the curves have been chosen from considerations of wear, and are far below the real safe stresses. Since a machine tool only runs for a small portion of its life on the lowest speed the wear at this speed is of less consequence than would otherwise be the case.

Large rolling-mill gears must be treated in a different way. Here it is necessary to provide against very heavy shocks, and strength is of paramount importance. Such gears are carefully plotted to find the minimum number of teeth in engagement, and the requisite pitch is obtained by considering the teeth as cantilevers subjected to bending. A normal safety factor, based on the ultimate strength of the material, is used in such cases.

Another interesting application of machine-cut, double-helical gears is the reduction of speed from high-power steam turbines. No other type of gear can be used for this class of work, because absolute smoothness of action is essential. The essence of this problem is to avoid excessive velocity by keeping the pinion diameter small, but at the same time it is undesirable to reduce the number of teeth below a certain point because absolute continuity of engagement must be maintained. The result of these conditions is that the gears must be of extremely fine pitch and great relative width. For example, a set of gears recently constructed for a 500-horsepower steam turbine, to reduce from 3000 to 300 revolutions per minute were 4 diametral pitch with face width 18 inches and pinion of 19 teeth.

There is probably no field of application for double-helical gears which offers such substantial advantages as for driving machine tools. In most modern machine shops there is a tendency to dispense with shafting as far as possible, and to drive the tools individually from separate motors. This method allows a more economical distribution of machines over the available floor space, and leaves the space overhead clear for rapid handling. On the other hand, motor-driven tools require far more gearing than when the drive is effected by belts, and it has been found difficult to obtain uniformity of motion under the new conditions. If machine-cut, double-helical gears are used for this purpose the quality of the work turned out is much improved and, by reason of reduced vibration, higher speeds and coarser feeds can be employed.

It has been already stated that double-helical wheels on the staggered system are usually made with a face width of about six times the pitch. This proportion has been chosen in view of the relatively fine pitches which can be used, so as to give wheels of normal proportions combined with a maximum of tooth surface in simultaneous engagement. The best spiral angle for the teeth is one which, within the width chosen, allows the engagement of the teeth to overlap under the worst conditions. An angle of 23 degrees satisfies these conditions. A steeper angle offers no advantages, but only serves to set up wedge action and to weaken the teeth on the normal section. The diagram, Fig. 5, shows the relative normal tooth pressures, pitch line sections and stresses for angles of 23, 45 and 60 degrees.

One of the greatest advantages of machine-cut, double-helical wheels is to be found in their adaptability for high ratios of reduction. The number of teeth which can be used with success in the smallest pinion lies far below the practical limit for straight spurs, and pinions of four or five teeth are by no means uncommon for special purposes. Since, however, the pitch can be made very fine, it is rarely necessary to reduce the number of teeth so far, and most high-ratio gears are made with pinions of 11 to 20 teeth. Pinions for high ratios are generally cut solid on their shafts, in order that the diameters may be kept low to bring the wheels within reasonable proportions.

Single wheels and pinions will transmit heavy powers with ratios between 10 and 20 to one, so that they can be used in place of worm gears or double trains of ordinary spurs. As against worm gears the gain lies in the direction of increased efficiency and life. A set of double-helical gears with 20 to 1 ratio has an efficiency of about 95 per cent. against a maximum of about 80 per cent. for a worm gear of equal ratio.

FIG. 7. DOUBLE-HELICAL GEARS WITH STAGGERED TEETH

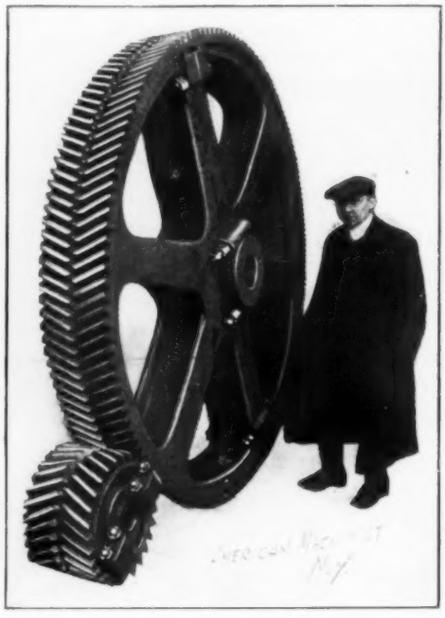


FIG. 8. DOUBLE-HELICAL GEARS WITH STAGGERED TEETH. A TYPICAL SET OF LARGE POWER PRESSES

FIG. 9. TYPICAL HIGH-RATIO GEARS WITH STAGGERED TEETH. RATIO 20 TO 1; 8 AND 160 TEETH; 1-INCH PITCH—9-INCH FACE

### An Interesting Application of Double-helical Gearing

An interesting example of this difference came under my notice a short time ago. A worm gear of first-class manufacture and modern design had been in use for some 2½ years, driving a deep-well pump from a 50-horsepower motor with reduction 480 to 22 revolutions per minute. This gear was replaced by a double train of machine-cut, double-helical wheels, the ratios being 480 to 60, and 60 to 22. The records of power consumption and pump duty were regularly kept, and after the new gear had been running for a year the figures showed a net saving of over 17 per cent. in its favor as against the average for the whole life of the worm gear. It was also shown that the efficiency of the double-helical gear had actually improved after a year's daily work, while the worm gear had steadily deteriorated in this respect from the day it was started.

Figs. 7, 8 and 9 show three sets of double-helical gears that are representatives of their design and construction.

### Important Points in Applying Double-helical Gears

In conclusion it is desirable to add a word of caution to those who are about to adopt this class of gear for the first time. It must not be forgotten that there are three fundamental points of difference between machine-cut, double-helical wheels and ordinary spur gearing:

(a) The pitch is finer,

(b) The face width is greater,

(c) The tooth pressures are generally higher.

To insure satisfactory working it is necessary that the shafts shall be parallel, true, and rigidly supported. The center distance must also be adjusted with great care on account of the fine pitch and small clearances allowed. Motor pinions of high-ratio gears should be mounted on extended shafts with an outer bearing. Anything in the nature of an overhung drive should be avoided wherever possible.

To avoid undue wear from magnetically controlled end-thrust in motors, the pinions should be mounted on two parallel feathers set at 180 degrees and carefully bedded to the keyways. See Fig. 6. The pinions should be a good tight fit on the motor shafts, but there should be just sufficient freedom to allow them to move along under the influence of continued side pressure, so that the motor armature can reach a neutral position where the pressure ceases. It is unnecessary to allow the pinions to slide freely on the shafts, and if this is done there may be trouble from excessive wear of the keys and keybeds. The best and most economical pitch-line velocities for ordinary gears, running open, lie between 500 and 1500 feet per minute, but anything up to 3000 feet is permissible in cases where there is no other choice. Wheels for high velocities should be balanced. Inclosed gears, particularly those used in connection with steam turbines, are run at speeds up to 5000 feet, but it is desirable to arrange a system of forced lubrication in such cases.

## Testing Gasolene Engines with a Fan Brake

By D. Ferguson*

In running off the tests of the motors used in the Pierce-Arrow cars, fan brakes are used to determine the power being developed. This method was originated by Col. Renard, of France. These fans are carefully calibrated so that the results are thoroughly reliable in every way. We first make an estimate of the power the fan will absorb as follows:

The speed of the disks in feet per second squared ÷ 450 = the pressure in pounds per square foot.

Speed in feet per second of the disks × pressure in pounds per square foot × 60 ÷ 33,000 = brake horsepower.

Example: With two disks 9 inches square, the combined area = 1.125 square feet; mean diameter of disks, say 49 inches.

For each revolution of fan, this will travel 12.8 feet. At one thousand revolutions per minute, their velocity = 214 feet per second. This squared and divided by 450 gives pressure of 102 pounds per square foot × 1.125 square feet combined area × 214 speed in feet per second × 60 = 1,470,000 foot-pounds ÷ 33,000 = 44½ brake horsepower = power absorbed at 1000 revolutions per minute.

This is only an approximate formula. To verify this, the fan should be calibrated. This need only be done for any one speed. The power can then be readily calculated for any other speed by the following formula:

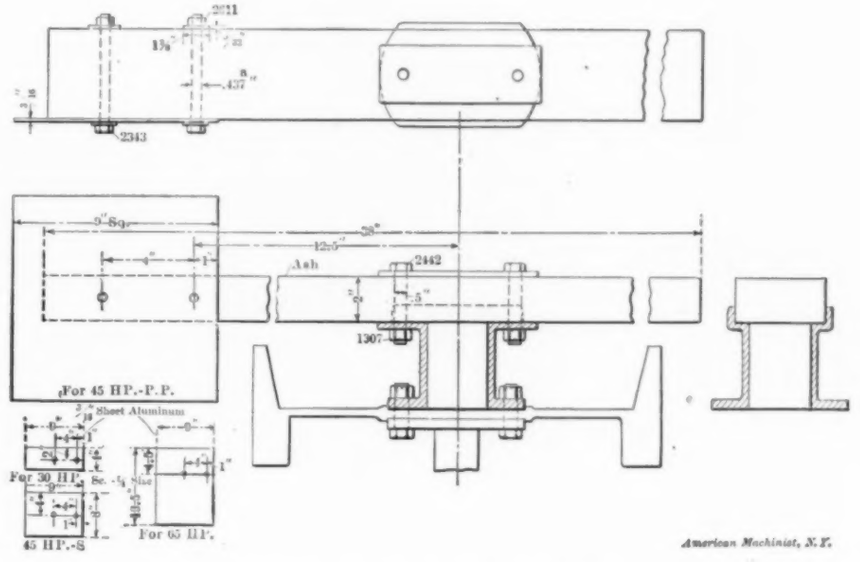
Speed for which power is desired = $A$.

Speed at which power is known = $B$.

Known brake horsepower at above speed = $C$.

$(A^3 \div B^3) \times C$ = brake horsepower.

To properly calibrate this fan, it should be coupled to an electric motor and the current consumption taken at the desired speed. As we are not equipped for this, we check our fan by taking an engine which we test by means of a prony brake, obtaining its maximum power at a certain speed, then keeping the engine adjustments the same, we put the fan on and alter the blades until it will run at the same speed as that at which the prony brake horsepower was obtained. This approximately gives us the brake horsepower absorbed by the fan at this speed. The above formula can be used for calculating the power absorbed at any other speed. The attached drawing shows the actual dimensions of one of these fans with the method of attaching it to the flywheel and crankshaft.




DYNAMOMETER FAN FOR 45-HORSEPOWER ENGINE

*Mechanical engineer, Pierce Arrow Motor Car Company.

---

One of the largest electric organs ever built in the United States, according to the *Scientific American*, is about to be erected in the Auditorium at Atlanta, Ga. It will be played from a movable four-manual control 65 feet away by an 8-volt current from a specially wound generator, and blown by a 20-horsepower motor direct-connected to a series of fans raising the air pressure by steps.

# Automatic Railroad Protection

## Mechanical and Electrical Devices Which Remove Control of Switches and Signals beyond the Possibility of Human Errors of the Tower Man

BY SNOWDEN B. REDFIELD

With a modern electropneumatic interlocking switch and signal system as a train is rushing over the track, it may be at more than a mile a minute, there is an invisible but irresistible influence pushing on ahead of the locomotive, which automatically binds every switch and signal on the track in an immovable grip for a mile in advance.

Most of us have seen from the rear platform of a train traveling over the road signal after signal change from white "clear" to the red of "danger." Some of us have also realized that a mile back other signals were changing from red danger to green "caution," and still further back from caution to clear again. The flash of these lights gives a feeling of security from the rear, but the idea of that rushing influence bounding on a mile ahead, paralyzing the track, as it were, into two cold bands of rigid unbroken steel, is almost weird. Not a switch can be turned, not a signal changed (except to danger) as a train approaches, but as the rear wheels click over the rails this wave of paralysis ceases, the locks release their grip, and the switches and signals come back to life again.

A general outline study of an electropneumatic, interlocking switch and signal system is well worth while, to show how mechanical and electrical devices are used to prevent railroad accidents. In order to illustrate a system of modern design having enough complication of switches and signals to be characteristic, and yet not so involved as to be difficult to grasp, the interlocking tower and switch and signal arrangement at Cranford Junction, N. J., on the Central Railroad of New Jersey, has been selected.

At this point there are four main through tracks, and one auxiliary freight track, each joined to a double cross-over leading to a junction with the Baltimore & Ohio railroad yards and a single cross-over operating in the other direction. The diagram in Fig. 2 illustrates the general track layout. The plant was constructed by the Union Switch and Signal Company, of Swissvale, Penn., and the idea is to so protect the many cross-switches by means of signal bridges at each end of the switch

FIG. 1. INTERIOR OF TOWER SHOWING SWITCH AND SIGNAL LEVERS AND INTERLOCKING MECHANISM

zone that it would be absolutely impossible to run two trains together, or to throw any train off the track, due to conflicting signals and switches. As long as the engineer obeys the signals given to him it may be positively stated that it is impossible in this electropneumatic interlocking system for the towerman to make a blunder leading to disaster. This result is arrived at by a system of automatic mechanical and electrical interlocking of switches and signals that removes their control beyond the possibility of human error.

Referring to Fig. 2, it will be seen that the two signal bridges stretching over the track at either end of the switch zone have mounted upon them various signals controlling the track and the switches between the bridges. In this zone there are two different kinds of signals; that is, automatic and semi-automatic. The automatic signals are shown on the eastern bridge on tracks 1 and 3, and they are represented by the white or unshaded flags in the diagram. At the western end these automatic signals are shown by similar flag diagrams on tracks 4 and 2. This will show that the automatic signals control the east-bound tracks east of the switch zone, and the west-bound tracks west of the switch zone. As a matter of fact, these signals have absolutely nothing to do with the switch zone itself, but are the regular automatic block signals covering the blocks to the east on the east-bound tracks, and to the west on the west-bound tracks. The towerman has no control at all over these automatic signals.

The towerman's duties are simply to throw the various switches in the cross-over tracks to connect with the junction, and to operate the semi-automatic signals shown by the shaded and half-shaded flags on the diagram, these signals protecting the switch zone before the trains reach this zone; that is, trains on the west-bound tracks to the east of the zone and on the east-bound tracks to the west of the zone. By means of these semi-automatic signals he can, therefore, at any time prevent a train from entering the switch zone, and he is powerless to throw any switch in the system unless the signal covering that track and switch is set at danger, preventing a train from running over it. These signals are semi-automatic in that they are thrown to danger position by the train as it passes. They are set at "clear" by the towerman when not

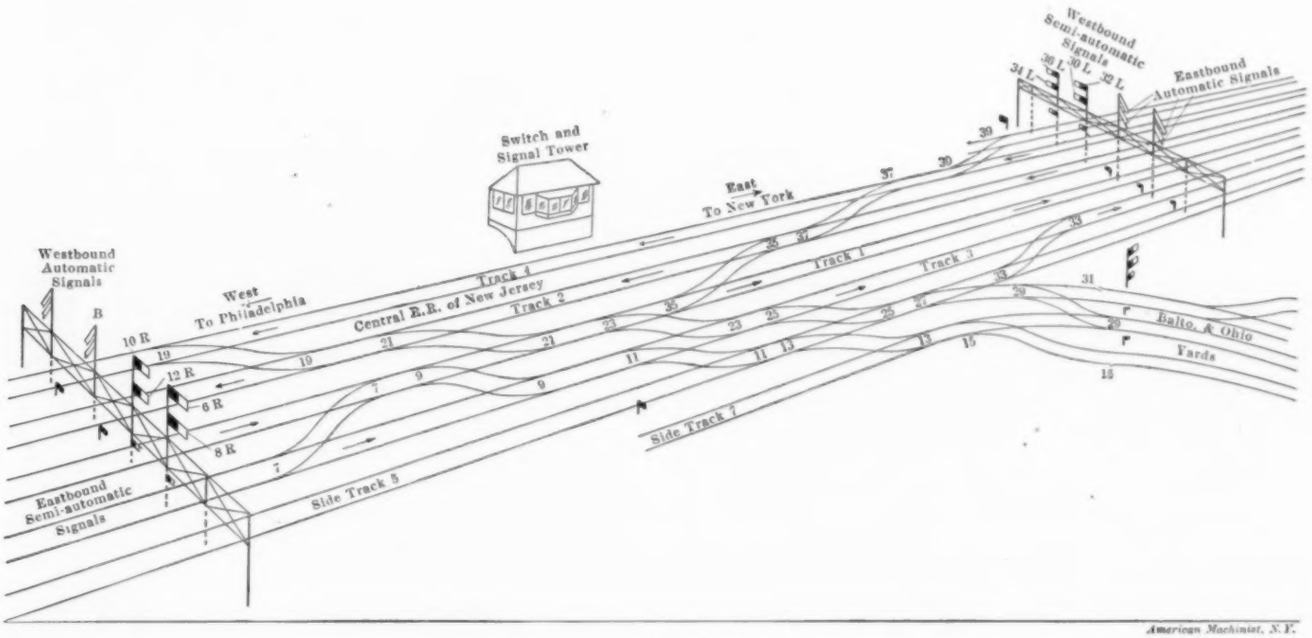



FIG. 2. DIAGRAM OF PLANT

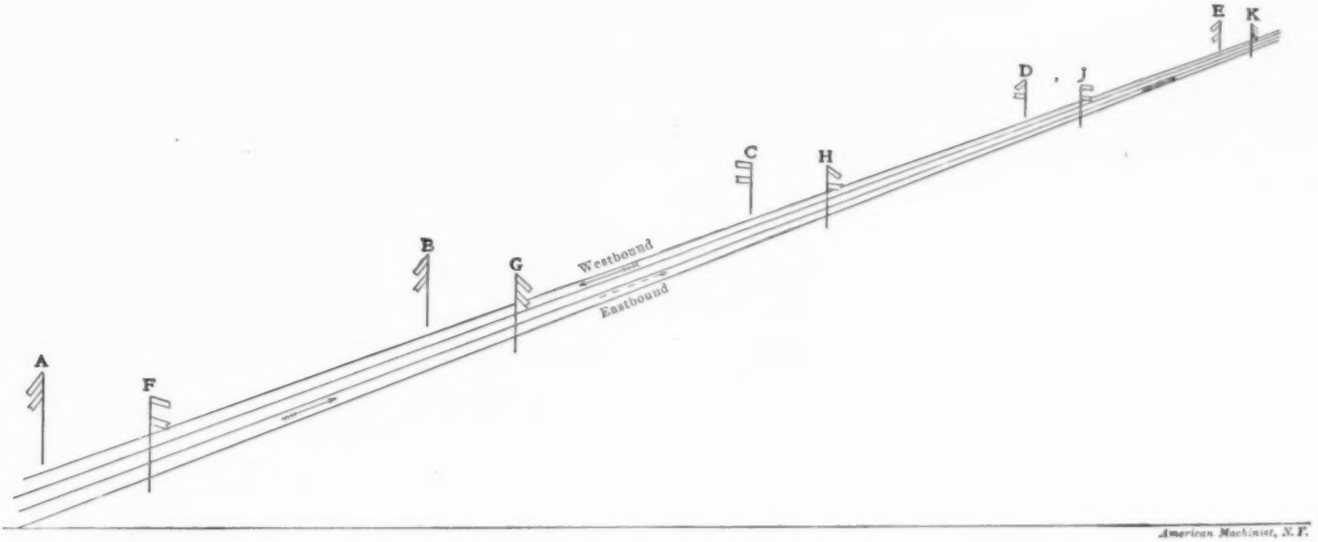



FIG. 3. DIAGRAM OF DOUBLE TRACK AUTOMATIC BLOCK SYSTEM

otherwise locked at danger and can be set at danger at any time.

### The Automatic Signals

First, as to the automatic block signals: Almost everyone knows that a modern railroad track protected by block signals is divided off into blocks one, two, three, four or five miles long, as the case may be, depending upon the congestion of traffic, and each one of these blocks is protected by signals at the beginning and ending. The arrangement of such a block system is shown in Fig. 3. In this figure there is shown a section of a double-track railroad divided off into four blocks.

On the further or west-bound track a train is supposed to be in the block *C B*, and on the nearer or east-bound track a train is supposed to be in the block *J K*, and also one in *F G*. Each signal pole will be seen to have two signals upon it; the upper one is known as the home signal, and controls the block next in advance of that signal. The lower signal is known as the distant signal and also controls the block next ahead of it, but while the home signal must be absolutely obeyed by a full stop when set at danger, the lower or distant signal simply means for the engineer to proceed under control, watching out ahead for the next signal, which, if conditions in front remain unchanged, will be set at danger or positive stop.

In an automatic system these signals are automatically operated by the trains themselves. The operation of the signals is by compressed air, acting upon pneumatic pistons in the signal mechanism. The compressed air is controlled by electric or magnetic valves, and the electricity is itself controlled by the trains passing over the track. The action is as follows: The wheels of the train in contact with the rails make a short-circuit on a 1-volt electric current from one rail to the other, and this short circuit operates a relay switch suitably located along the track, which in turn throws a 14-volt electric current into a system of wires leading to the various signals. This 14-volt circuit operates the magnetic valves on the compressed-air cylinders, which work the signals up and down in response to the electric current.

### Danger or Caution

Referring to Fig. 3, suppose that on the west-bound track there is a train in the block *CB*, assuming also that there is no train nearer than three blocks ahead of this one, the signals at *B* will both be in the "clear" position; that is, showing the signal board in a diagonal slant. The signals at *C* will both, however, stand out straight from the pole in a horizontal position, indicating danger; that is, that there is a train in the block *C B*, going west. At the same time at *D* the upper or home signal will indicate a clear track in the block *D C*, but the lower or distant signal will stand out in the caution position, showing the engineer of a following train that while the block *D C* is vacant, the block *C B* is occupied by a train.

On the lower or east-bound track a similar condition will be seen; that is, a train in the block *J K* will be protected at *J* by two signals indicating danger, while at *H* the home signal will be at clear and the distant signal will be at caution. At *G* again both signals will be at clear, so that a train in the block *F G* going east and following the train in the block *J K*, as long as they remain separated as shown, could travel at full speed. If, however, the train in the block *F G* should by any chance enter the block *G H* before the train in the block *J K* had passed beyond the signal at *K*, the engineer of the following train seeing the cautionary board at signal *H* would slow down his train, keeping it under control, and would continue at slow speed until he had completely traversed the block *H J* and reached the signal *J*.

If by that time the train in the block *J K* has made up its lost time, the signals at *J* will both be at clear, or if the first train is only two blocks ahead, the home signal at *J* will be clear, and the distant signal will be at caution, just as at *H*. Under these conditions the engineer of the following train would still proceed with caution until he should reach some signal pole where both signals are at clear, as at *G*, when he would be again permitted to put on full speed.

As said, in an automatic system these signals are entirely automatic in their operation and are controlled through the short circuiting of a low-voltage current from one rail to the other by the train wheels and axles. In walking along a railroad track controlled by automatic signals the bonding wires between the rail joints are very easily seen and it is these bonding wires that carry the current back to the relay when the tracks are short circuited by a train, to control the main current which operates the signals.

The towermen do not have any control over these automatic signals, and it is this type of signal which is represented

FIG. 4. DETAILS OF MECHANICAL INTERLOCKING

*A*, movable dogs.
*B*, fixed dogs.
*C*, sliding cross bars.
*D*, longitudinal sliding bars from levers.
*F*, electric locks.

by the open or unshaded flags on the bridges shown in diagram of Fig. 2.

### Semi-automatic Signals

Now, as to the semi-automatic signals:

FIG. 5. BACK VIEW OF LEVER CASE
*A*, electric commutators.
*B*, solenoid of electric lock.
*C*, electric lock.

Looking again at Fig. 2, suppose a train were traveling westward on track 2. Before the train reaches the distant signal two blocks down, the passing of the wheels over the rails causes a bell to ring and a red ball indicator drops in the tower announcing the approach of the train. If at this time all of the switches on track 2 are in proper shape to receive a train, the operator swings a small hand lever in the tower which puts signal 32 L to clear. This motion is automatically transmitted to the distant cautionary signal which also moves to clear, so that the approaching train can come on at full speed, knowing that at least two blocks in advance are free from obstruction.

As soon now as the towerman has changed these signals to clear and the train has entered the block past the distant signal, the action of the wheels on the rails short circuits the low-voltage current to operate the relay in the tower, which in turn throws in an electric lock on the signal lever in the tower. This in turn throws a system of mechanical locks between the levers so that no switch connecting with track 2 may be changed while the train is approaching. This is that protecting influence which is ever going on ahead of the train. If it were not for this locking influence, the towerman might see fit to change his mind and think that he might be able to turn one of the switches for moving a switch engine, for instance, before the approaching train arrives. This, however, he is absolutely prevented from doing after the train has entered the second previous block under a clear signal, by the action of these automatic electric and mechanical locks.

One thing the towerman may do in case of necessity, and that is he can by a partial motion of the lever throw signal 32 L to danger, but while this will stop the train, the towerman can still in no way alter any of the switches on track 2, so that if the engineer were unable to check his speed in time to obey the signal, his passing over the switch zone would not imperil the safety of his train. This is to eliminate the possibility of throwing a switch directly in front of a locomotive, which has so often been done by a rattle-brained towerman, resulting in the derailing and overturning of a train.

These switches will remain locked rigidly until the train has passed beyond the switch zone; that is, has passed the next signal bridge carrying the automatic signal at the western end. When the train has reached this point the automatic locks release themselves, and the towerman may again manipulate the switches to suit the conditions of traffic.

### One Minute and Ten Seconds in which to Think

There is one other thing which can be done while the train is standing under the signal 32 L, if it has been brought to a stand-still, and that is by the grinding of a certain crank in the tower for one minute and ten seconds he can unlock the various switches and throw them over. This time element gives a chance for one of two things to happen; either the train will have gotten beyond the switch zone by the time he gets through turning the crank, or else during the interval of one minute and ten seconds the towerman will have had a chance to become completely sane and is in condition to operate with a clear knowledge of what he is doing.

### The Works

Now as to the throwing of the switches and signals by compressed air and electricity. In the tower there is a long counter or case, not unlike the show cases so familiar in stores. In front of this case there are two rows of short levers which may be swung by hand through an angle of approximately 90 degrees. The axes of these short levers extend directly into the front of the case and by means of bevel gears each one of these levers rotates an electric commutator at the back of the case upon which there are numerous copper bands and contact points somewhat like the inside of a trolley car controller. Rotation of the contactors causes the making and breaking of various electric circuits which operate through relays taking the place of multiple switches, which in turn control other electric circuits going to the pneumatic cylinders on the switches and signals along the tracks.

Signals are moved by an air cylinder and a single magnetic valve. By the operation of a signal lever in the tower suitable electric currents are sent out which operate the magnetic valve on the air cylinder of the signal causing the air to flow into the cylinder and throwing the signal to "clear." The signals are so made that the action of gravity alone will make them stand in the "danger" position and it is only the operation of the electric current and the air in continuous application which will hold the signal to the clear position. This, of course, is a matter of safety as in case of any sort of derangement of the mechanism the signal itself will automatically go to "danger," thus holding up a train until the cause of the derangement has been found.

On the air cylinders of the switches there are three magnetic valves. One of these valves throws the air upon one end of the pneumatic cylinder to throw the switch in one direction and another valve throws the air on the other end of the pneumatic cylinder to reverse the switch. The third magnetic valve is in the center and this controls a little lock mechanism which prevents the throwing of the switch by any means except the proper control of the electric circuit. This little lock is composed of a pin in the main slide valve of the cylinder, this pin being controlled by a small air plunger which in turn is controlled by the magnetic lock valve.

As intimated, the pneumatic cylinder is controlled by a main slide valve. This slide valve is operated by two small plungers, one at each end and these plungers are themselves controlled by the magnetic valves which are controlled from the tower. In this way an electric current operates a small magnetic valve which throws air on one end of the slide valve plunger, moving the slide valve to the proper position, and this in turn throws the full air pressure on the main plunger of the switch cylinder, throwing the switch positively over.

### Moves It; Locks It; Indicates It; Detects It

The motion of the main plunger does four things. First, it moves the switch. This is caused by the passage of a roller in front of a cam known as the alligator jaw. This causes a bell-crank lever to operate, throwing the switch as desired. Near the alligator jaw there is a lock mechanism which throws a heavy steel bar through a rectangular opening in a cross bar connected with the switch and this locking is produced after the motion of the plunger has been sufficient to throw the switch one way or the other, the lock positively holding the switch either open or closed.

Beyond this again there come what are known as the indication circuit contacts. This indication circuit is so connected up with a system of electric locks on the levers in the tower that the towerman knows instantly whether or not the switch has moved in obedience to his lever. The action is as follows: The towerman moves the small switch lever in the tower, which as before described turns the electric commutator directing the electric current through the relays down to the magnetic valves on the side of the pneumatic cylinder of the switch, throwing the air on the main plunger and moving the switch. Up to the time when the switch has made its complete motion, it will be found that the towerman is absolutely unable to push the small hand lever over to the extreme position. He must wait for an instant with the lever in mid position until the switch has been completely thrown and locked and the other indication circuit completed by the plunger. This indication circuit then, when the switch has been completely thrown, unlocks the electric lock on the hand lever in the tower so that it may be pushed over to its final position.

The object of this is that while the switch lever is in mid position every other switch lever and signal lever connected with this switch is rigidly locked by a system of mechanical cams so that

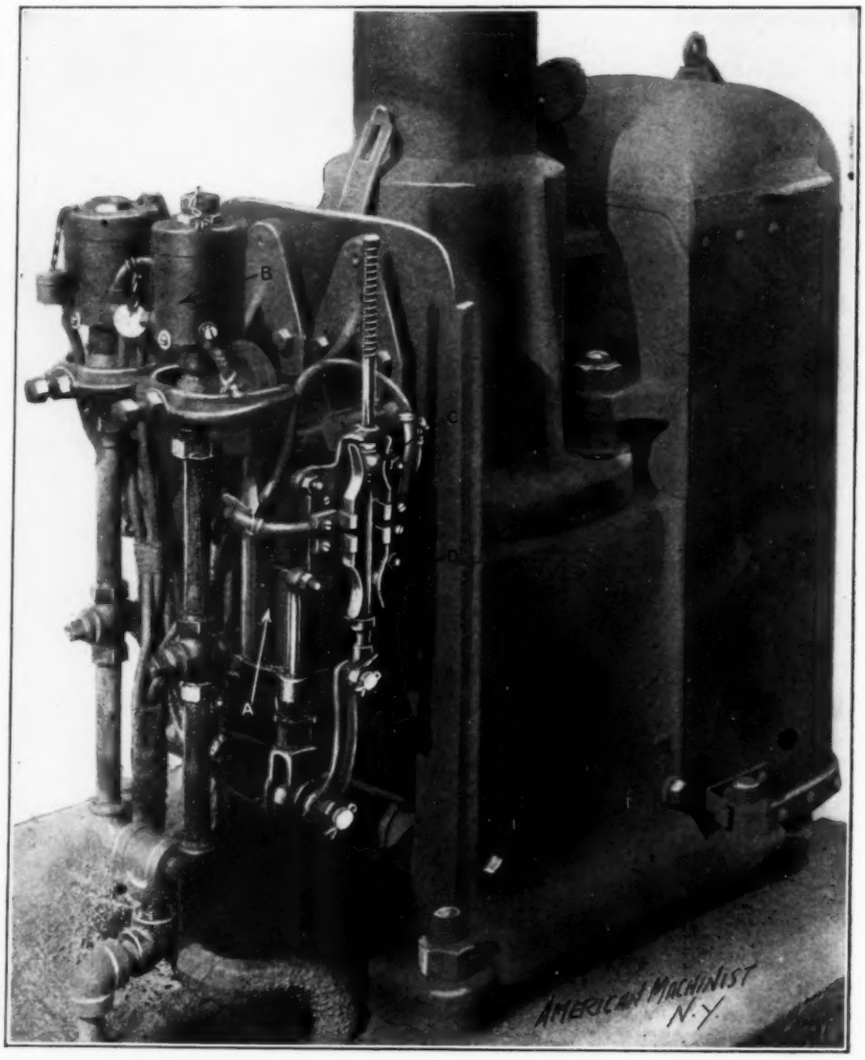



FIG. 6. SIGNAL MECHANISM

*A*, pneumatic cylinder.
*B*, magnetic air valve.
*C*, indicating lock contact.
*D*, distant signal contact.

no other switch or signal may be thrown to allow a train to enter a partially or imperfectly thrown switch.

The fourth motion is that of the detector bar on the switch which will be described later on.

### Mechanical Interlocks

This brings us to the system of mechanical interlocks on the hand levers in the tower. Each lever, by means of a small quadrant, operates a horizontal sliding bar; these bars being in parallel rows along the full length of the case. Crossing over these bars there are numerous other bars continuous in some places and broken in others. By a system of dogs fastened rigidly on to the lever bars the throwing of one lever will so block the cross bars that certain other lever bars are rigidly held by suitable dogs so that the levers themselves cannot be moved. Also by a system of movable dogs carried by some of the other lever bars, various combinations may be made so that by throwing lever No. 1 for example, lever No. 3 may be locked only when lever No. 2 is in a certain position; or lever No. 1 may be locked when No. 2 is in one position and No. 3 in another. Almost any combination may be obtained with these cross bars and dogs, both movable and fixed, and a whole series of interlocks may be arranged so that when certain levers are moved in connection with certain other levers, still others are locked in certain positions.

Thus it will be seen that the switch and signal levers are controlled by both electric and mechanical locks. The electric locks hold the signal levers and these in turn mechanically hold the switch levers from being moved when a train is approaching. This we have called the advance influence. Also the electric locks operate through the indication circuit when a switch or a signal is in the mid-way position while being thrown as described. The mechanical locks are between the signals and switches themselves and no switch can be thrown, as already said, unless the signal controlling that switch is set at "danger" first. After this signal has been set to "clear" it is impossible to change the switch until the signal has been put back to "danger" again. Also the signal cannot be put to "clear" unless the switch is in the position corresponding to the "clear" position of the signal. Neither can switches be thrown to conflict with each other, nor signals be given to contradict each other.

### The Signals Have It, Too

It has been said that the indication circuit locks the switch lever in a half-way position until the switch has been completely thrown and that when the switch lever is in the half-way position, the mechanical locks from one lever to another prevent any other changes in the switches or signals involved, from being made. There is also an indication circuit in connection with the signals.

When a signal has been set to "clear" it cannot be set back to danger in one motion of the lever. A double motion similar to that required to move a switch is necessary, for when the signal lever has been started, the indication circuit causes an electric lock to be thrown on the lever which holds it in a part-way position until the signal has gone to the absolute danger position, when the lever motion may be completed. The object of this is to insure that the towerman does not make any other alterations to the switches or signals until he is certain that the signal has really gone to "danger," because while his lever is in the partial position, it is again impossible, due to the mechanical locks, to change any other levers controlling switches or signals interfering with this signal.

It is this part-way position of the signal lever also which allows the towerman to throw a signal in front of a train which is in the next block, but does not allow him to change any of the switches. Suppose for instance, that when the annunciator has rung indicating the approach of a train, he gives the train the "clear" signal and then finds that for some reason, it is necessary to stop this train. He can then move his signal lever to the partial position which will throw the signal to "danger," but as the train itself is in the neighboring block, what we have called the advance influence operates the electric lock to prevent the signal lever from being thrown to the complete danger position. While it is held in the part-way position, the mechanical locks on the cross bars with their dogs, will prevent the changing of any of the switches in front of the train.

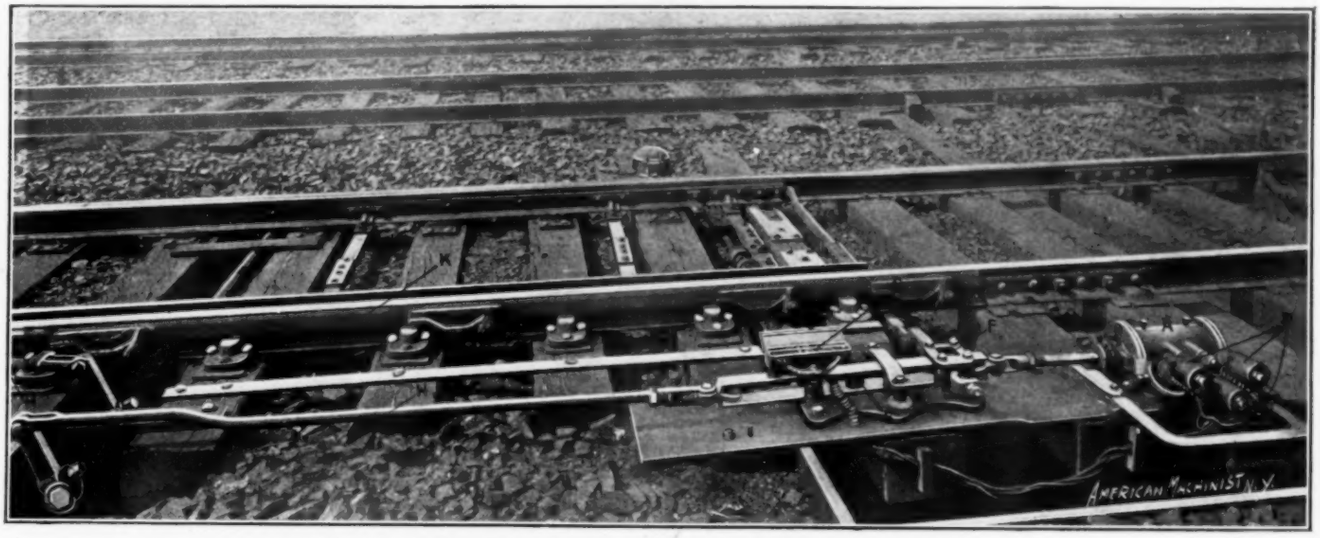



FIG. 7. SWITCH MECHANISM

*A*, pneumatic cylinder.
*B*, magnetic valves.
*E*, alligator jaw.
*F*, track lock.
*G*, indication contacts.
*H*, rod to detector bars.
*K*, detector bar.

### Detector Circuits and Bars

After the train has once entered the switch zone its safety is assured by what are known as the detector circuit and detector bars in connection with each switch. As the train passes under a semi-automatic signal, this signal automatically swings to "danger" to hold any following train. It will be recalled that when this signal is at danger after a train has once left the previous block, the switch levers would naturally be unlocked. Under these circumstances something must be done to prevent the switches directly in front of and under the train from being tampered with. This is the duty of the detector circuit and bars. The detector circuit through the train wheels throws the electric locks in the tower to hold every switch lever immovable until the train has passed.

Detector bars are long steel plates resting on swinging arms attached to the rails of a switch and whenever a switch is thrown, the detector bar rises up beside

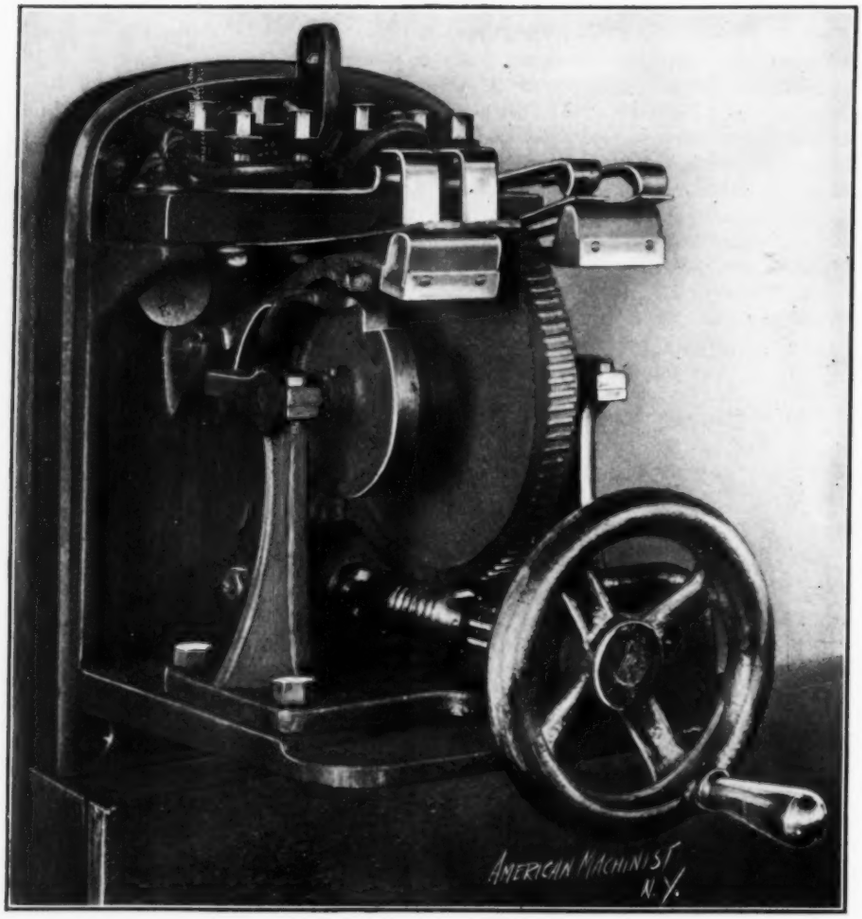



FIG. 8. THE TIME-THINKING DEVICE

the track, distinctly above the rail and then drops down again when the switch has reached its final position. The object of these bars is to further prevent the throwing of a switch under a train. As long as the train is on top of the switch, the detector bar is held down by the wheels of the train itself and the switch cannot be thrown while the bar is held down.

### No Imperfect Switching

Beside some of the switches there is also a little box containing what is often called the pole changer, but which should really be known as the circuit controller. Inside of this little box there are the various terminals of the electric circuits leading to the magnetic valve on the signal which controls that particular switch. The throwing of the switch itself causes, by means of a bar and a suitable lever, the interruption of the electric signal circuits inside of the small box. The object of this is to further insure that the switch and signal shall agree with each other in their position. This little box is used principally on what is known as a facing-point switch, that is, a switch which faces the direction of traffic.

It is easily seen that for a train to pass over a switch facing the train, it is absolutely essential that the switch point shall be rigidly against the side rails in order to prevent derailing the train. In case through any fault in the mechanism one of the facing-point switches should be open, say ¼ of an inch, the rod and

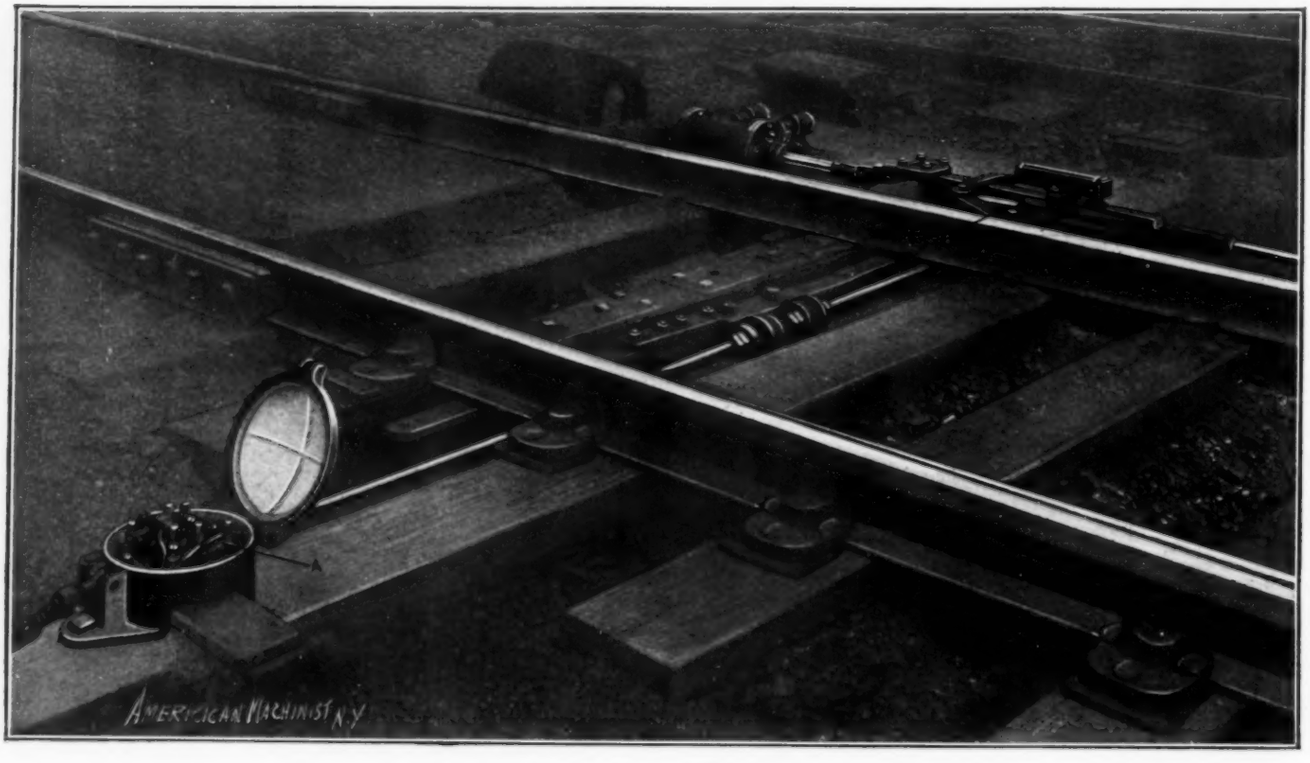



FIG. 9. FACING POINT SWITCH MECHANISM

*A*, circuit controller.
*B*, alligator jaw.

lever reaching to the circuit controller beside the track would disconnect the electric circuit leading to the signal governing that switch and this signal would be immediately thrown by its weight to the "danger" position so that an approaching train would have to stop before it could pass over the defective switch.

### The Meat of the Matter

A summary of all these conditions may be drawn up when it is said that any signal in a "clear" position locks all switches involved by means of the mechanical bars, cross bars and dogs in the case in the tower. The indication circuit electrically locks the lever controlling a switch or signal during the time that it is being thrown and until its complete motion is assured. This electric lock holds the tower lever in the partial position, which in turn, as already said, throws the mechanical locks to hold all other levers involved. The detector circuit is operated by the approaching train and puts an electric lock on the various levers operating the different switches in the track so that they cannot be moved until the train has passed. The pole changers or circuit controllers insure that the signal and the switch, especially the facing-point switch, agree with each other in their positions and assure that no signal can be thrown to the "clear" position when a facing-point switch under its protection is not tightly closed.

### An Example

In such a system of switches as that shown in Fig. 2 in order to take a train from track 4 to track 5, or all the way across the system, it would first be necessary to set all approach signals on both bridges to the "danger" position, thus unlocking the various switches. After this, by throwing in series one lever after another, the switches 19, 21, 23 and 25 can be thrown to carry the train from track 4 to track 5 or, if 27 is also thrown, out into the Baltimore & Ohio yards. If at any time between the throwing of any two switches, the signal covering the arrangement already made in the switches should be put to the "clear" position, this would immediately lock all the other switches having access to these tracks and it would be impossible to throw these switches while the signal was in the "clear" position. For this reason, the signal is not moved to "clear" until all the switches have been thrown. After this, the throwing of the signal to "clear" will lock all the switches involved, holding them in their proper position, while the detector circuit and bars hold them, once the train has entered the block and the signal has again automatically swung to danger to protect the train from the rear.

### The Human Engine Driver

All of this wonderful system of locks and interlocks insures absolute safety from the human failings of the towerman, but what about the human engine driver? Several times the engine driver of a limited train has been found dead in his cab with his train rushing past signal after signal. What protects the passengers in this case? Nothing.

This is the weak point and although much time has been spent on the subject and much money wasted by misguided inventors, the steam railroads have done little or nothing to automatically check the locomotive engineer and it is his blunders and failures to obey which cause most of the disastrous wrecks with which the newspapers are filled.

The problem of automatically checking the locomotive man is of the very simplest character and much comfort should be felt by thousands upon thousands of passengers on the New York City and other subway trains. On these systems, not only are the switches and signals rigidly interlocked and "fool proof," but if any trainman takes it upon himself to pass a danger signal a lever in the track, controlled by the signal, will reach up and apply the air brake with such vigor as to throw every "strap-hanging dividend payer" from his feet. This is not all, for not only would the innocent strap hanger have to suffer, but the trainman would have to crawl under every car to release the brake from its rigid grip. With this process in mind, it is indeed a badly muddled trainman who passes a danger signal.

## An Indexing Turret Chuck

By R. Stephens

The sketches show a revolving chuck used for boring, facing and tapping valve bodies. By its use all work is finished, at one handling, without stopping the machine and the three holes are tapped true with each other. A sectional view is shown in Fig. 1 with the valve body fixed ready for machining; Fig. 2 is an end view from the front, and Fig. 3 a back-end view, showing the hand lever and carrier, which is self-explanatory.

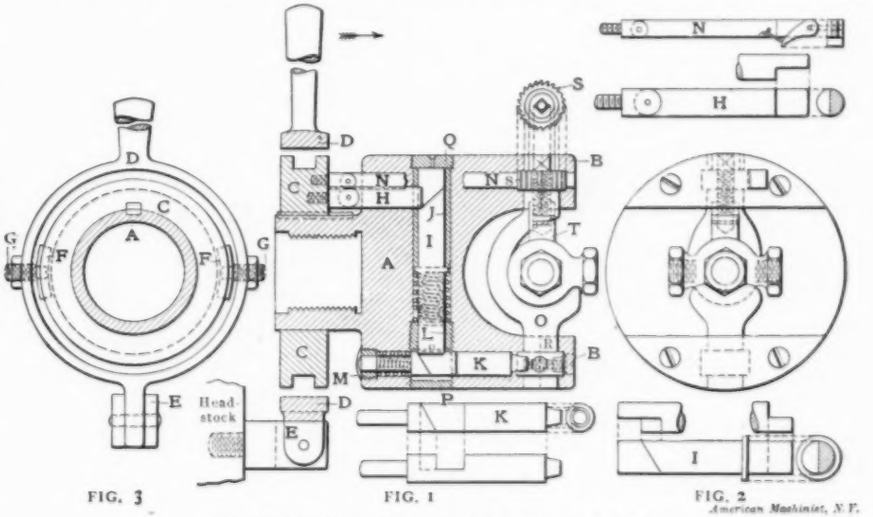



FIG. 3 FIG. 1 FIG. 2

American Machinist, N.Y.

AN INDEXING CHUCK FOR THE TURRET LATHE

The body *A* is made of cast iron and fitted with caps *B B* which are fixed with four fillister-head screws. The body is threaded to fit the lathe spindle; turned all over; bored to take plunger *H*, hard-steel sleeve *J* and indexing plug *K* bored and recessed for chuck jaw *O*, on which the indexing collar *R* and ratchet *S* are mounted; tapped for headless screws *P* and *Q*, hard-steel brushes *L* and *M*; and squared out to take lever and pawl *N*.

The carrier *C* must slide freely on the neck of the chuck and all holes for plungers, etc., must be nicely finished to insure smooth movement.

To revolve the work the hand lever *D* is moved forward in the direction of the arrow, then back to its original position. During the forward movement the pawl *N* rides over the ratchet *S* and the plunger *H* and engages on the beveled part of *I*. This causes it to move forward *I* and this in turn acts similarly on plug *K* to withdraw it from the indexing collar *R*. On the return movement of the lever *D* the pawl *N* engages on the ratchet *R*, thus revolving the work; at the same time plunger *H* is withdrawn and allows one spring to force back *I* and this allows the other spring to force plug *K* into the indexing collar *R*. This locates the jaw in the next position.

The chuck jaw is drilled and tapped at the ratchet end to take the clamping screw *T*; counterbored for a box key; and recessed so that clamp *T* can be withdrawn far enough to allow the valve bodies to be easily inserted and taken out.

The knuckle joint *E* is fixed to the headstock. All wearing parts are made of cast steel and hardened; *A* and *C* are cast iron, *D*, *E* and *O* are mild steel.

Sleeve *J* is made a tight fit to the body and cut away to allow plunger *H* to pass. Plunger *H* and pawl *N* are fitted with knuckle joints to insure smooth working. The flats on *H*, *I* and *K* must always slightly overlap to prevent rotation.

Hardened brushes *L* and *M* act both as bearings for the plungers and stops for the springs. Headless screws *P* and *Q* are to keep out chips, dirt, etc., while *Q* also serves to hold the sleeve *J* in position. Oil holes which also act as vent holes, are drilled through these screws.

This chuck can be used for a large variety of work with any reasonable number of sides by use of suitable jaws and indexing collars.

## The Machinery Trade of the United Kingdom in 1908 —Imports and Exports

By Archibald J. Wolfe

The first volume of the "Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions for 1908," just issued, contains some interesting figures for the imports and exports of machinery. The British statistics for 1908, as far as machinery is concerned, involve an entire change in classification, for which reason comparative statistics for various groups are not available, but only the totals of imports and exports can be compared with those for preceding years. The changes in classification referred to are to be welcomed because they afford a better insight into the trade in various classes of machinery that had formerly been merged in larger groups. Thus, for instance, for the first time machine tools are specially mentioned, and the figures for imports and exports of these are now given, together with the names of countries of origin and destination, respectively.

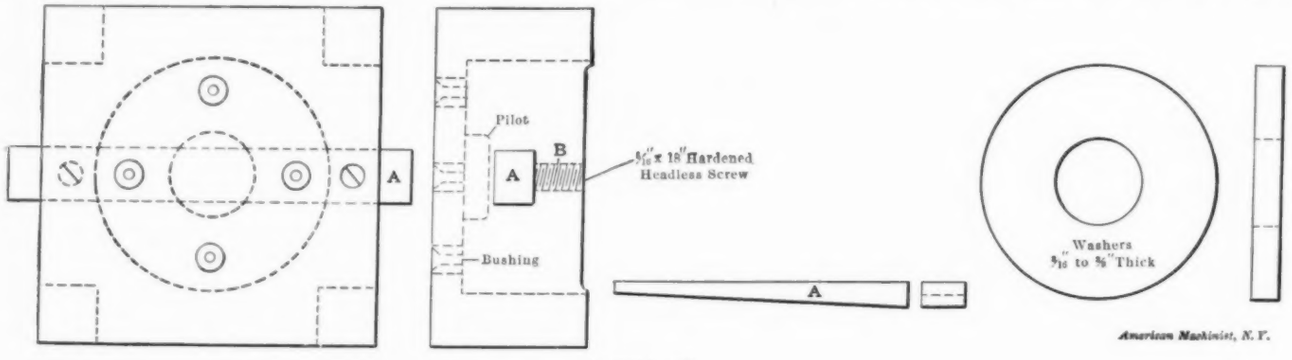
The old classification of machinery in the preceding annual statements was as follows: Steam engines, locomotive; steam engines, agricultural; steam engines, other description; machinery not being steam engines or electric machines, agricultural; sewing machines; mining machines; textile machines; electrical machines of all kinds.

For 1908 the following classification of imports: Prime movers (except electrical)—rail locomotives; ditto, road locomotives, including steam railways; ditto, agricultural; ditto, pumping; ditto, other descriptions. Prime movers, electrical of all kinds; machinery not being prime movers or electrical machinery—agricultural; boilers; machine tools; mining machinery; sewing machines; textile; typewriters; machinery, not being prime movers, of other descriptions.

The total value of machinery of all kinds imported into the United Kingdom for 1908 amounted to £4,552,904 (about $22,764,520). The imports from foreign countries were £4,438,331 (about $22,191,655); from British possessions, £114,573 (about $572,865).

| | Tons. | Value (about). | |
|---|---|---|---|
| The imports of machine tools from the United States of America were in 1908 | 798 | £ 99,014 | $495,070 |
| From other foreign countries | 189 | 16,494 | 82,470 |
| Total | 987 | £115,508 | $577,540 |

The table of exports of machine tools, the manufacture of the United Kingdom, to foreign countries and British possessions is given in the accompanying table.




A DRILL JIG

| | Tons. | Value. £ | Value. Dollars (in Round Figures). |
|---|---|---|---|
| To Germany | 58 | 10,706 | 53,530 |
| To France | 355 | 25,409 | 127,045 |
| To Italy | 197 | 11,500 | 57,500 |
| To Japan (including Formosa) | 2,477 | 110,620 | 553,100 |
| To Chile | 240 | 12,340 | 61,700 |
| To Brazil | 318 | 16,340 | 81,700 |
| To Argentine Republic | 470 | 23,868 | 119,340 |
| To other foreign countries | 1,275 | 69,036 | 345,180 |
| Total to foreign countries | 5,390 | 279,819 | 1,399,095 |
| To British South Africa | 69 | 4,543 | 22,715 |
| To British East Indies | 1,465 | 69,491 | 347,455 |
| To Hong Kong | 187 | 9,576 | 47,880 |
| To Australia | 652 | 29,791 | 148,955 |
| To New Zealand | 213 | 13,130 | 65,650 |
| To other British possessions | 207 | 10,031 | 50,155 |
| Total to British possessions | 2,793 | 136,562 | 862,810 |
| Total | 8,183 | 416,381 | 2,801,905 |

EXPORTS OF MACHINE TOOLS, DURING 1908, MANUFACTURED IN THE UNITED KINGDOM.

The exports of machine tools of foreign manufacture from the United Kingdom for 1908 (being machine tools shipped to the United Kingdom for transport to other countries) were as follows:

| | Tons. | £ | Dollars. |
|---|---|---|---|
| To Sweden | 15 | 984 | 4,920 |
| To Germany | 9 | 4,263 | 21,315 |
| To Portugal | 3 | 1,322 | 6,610 |
| To United States of America | 19 | 5,380 | 26,900 |
| To Argentine Republic | 8 | 1,381 | 6,905 |
| To other foreign countries | 22 | 2,500 | 12,500 |
| Total to foreign countries | 76 | 15,830 | 79,150 |
| To Natal | 19 | 1,254 | 5,270 |
| To British India | 6 | 2,304 | 11,520 |
| To other British possessions | 5 | 721 | 3,605 |
| Total to British possessions | 30 | 4,279 | 21,395 |
| Total | 106 | 20,109 | 100,545 |

EXPORTS OF MACHINE TOOLS OF FOREIGN ORIGIN, FOR 1908, FROM THE UNITED KINGDOM.

## A Drill Jig

By Morris Goldberg

I had a cheap hurry-up job to make a drill jig for different thicknesses of washers, as shown, and could not find a quick way to clamp them in the jig without using a screw till I hit on this plan. Using the wedge *A* is old, but I do not think the screw adjustment has been used before. We used the jig and it worked finely.

By simply putting a washer on the pilot and putting in the wedge *A*, then screwing the screws *B* up to the wedge tight, I drilled that lot, then set it in the same way for other thicknesses.

In an interesting paper presented before the American Society for Testing Materials covering the corrosion of basic open-hearth steel, a test of five samples was cited which contained the following amounts of manganese: 0.07, 0.12, 0.16, 0.24 and 0.37 per cent. The carbons ranged from 0.04 to 0.06 per cent., and the sulphur and phosphorus from 0.01 to 0.018 per cent. The fencing made from the above wires was put up in September, 1908. An examination made recently showed that there was practically no difference in the corrosion of the various samples.

# Practical Letters from Our Readers

## A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

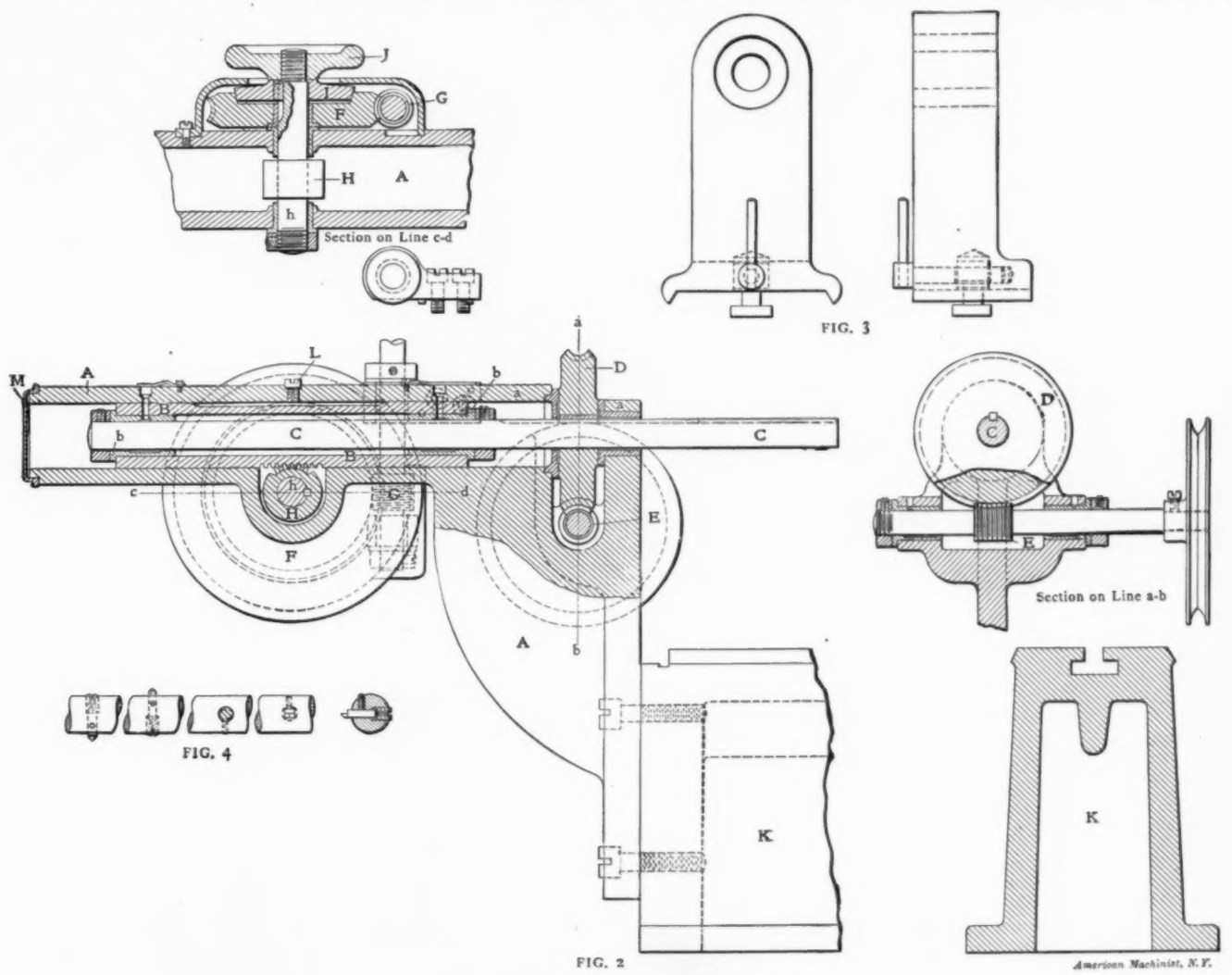
## WE PAY FOR USEFUL IDEAS

### Boring Fixtures for Bench Lathe Heads

The accompanying drawings will give an idea of two methods used by two large firms for boring bench-lathe heads. The first fixture, illustrated in Fig. 1, is designed to be used in conjunction with the engine lathe, while the second is a complete machine in itself, as shown by Figs. 2, 3 and 4. The principle remains the same in each, that of supporting the heads on a standard-size bed, and boring out with a cutter bar supported by false heads of standard distance between center of bushings and ways.

In Fig. 1 the casting *A* supports the piece *B* by means of the shaft *C* and the ball joint *D*, cushioned by the spring *E* and nut. The piece *B* has two projecting ledges *b b* which support the standard bed *F*, as shown in the drawing. On this bed are clamped the two false heads *G G* and the head to be bored *G'*, which is shown in dotted lines. The cutter bar *H* is supported by the false heads and has two inserted cutters *h h*, so spaced as to act on both uprights of the head at once. These cutters *h h* are adjusted and clamped in position by the set screws, as shown. The fixture is mounted in place of the tool post on an engine lathe, being clamped in position by the T-headed nut *J*. The cutter bar is driven by the lathe spindle by means of a long bar with a taper at one end and universal joint connecting with the cutter bar at the other end. The regular lathe feed is used, the head to be bored being retained in position by means of a stop *I*. To accommodate different sizes of heads, there are different standard beds and false heads made which are interchangeable in the piece *B*.

In Fig. 2 is illustrated a self-contained fixture consisting of the casting *A*, which is bored out to receive the shell *B*, which is in turn bored out for the two bushings *b b* carrying the drive rod *C*. Between the forks *a a* of the casting *A* is the worm wheel *D*, which is actuated by the worm *E* and drives the shaft *C*, a square key, as shown, allowing the shaft to move forward while rotating at the same time. Another worm wheel *F* and worm *G* drive the pinion *H* mounted on the shaft *h*. This furnishes the feed for the cutter




LATHE HEADS FOR BENCH BORING FIXTURE

bar. In order to facilitate rapid setting and manipulation of the cutter bar after it is coupled to the drive shaft *C* (a universal joint intervening), a friction clutch *J* is arranged so that by tightening or loosening handwheel *J* the shell *B* may be readily moved to any position or clamped so as to travel only at the rate of speed determined by the worm and wheel.

The shell *B*, of course, has rack teeth its entire length, and not for a short distance only, as shown. Casting *A* is attached solidly to the bed casting, a cross-section of which is shown in the view to the right. The heads to be bored are clamped upon this bed in the usual manner, and the cutter bar is supported by the false heads shown in Fig. 3, and arranged similarly to that described in connection with the first fixture. The cutters are also arranged as described before. This machine is made large enough to take two heads at once, and the four cutters are placed as in Fig. 4, 90 degrees apart, to reduce as much as possible any tendency to spring. The screw *L*, Fig. 2, keeps the shell *B* from turning, and by removing this screw and the cap *M* the shell *B* and driving shaft *C* can be easily withdrawn for cleaning and oiling.

Springfield, Ill. F. W. B.

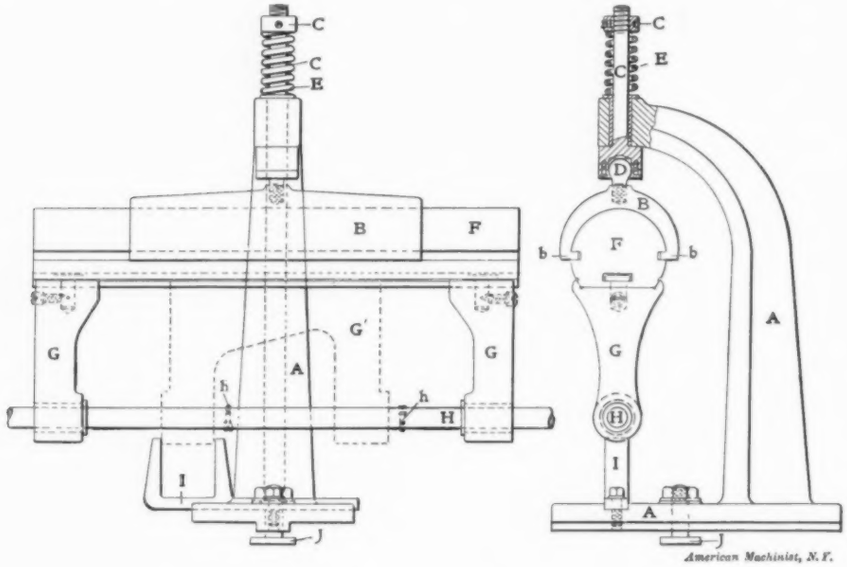



FIG. 1. FIXTURE FOR BORING BENCH LATHE HEAD

## Asbestos for Babbitting

For forming babbitt metal, use asbestos and cylinder oil mixed instead of clay or putty. It can be kept for months ready for use, leaves no grit as clay does, and does not get hot like putty.

After once trying, no shop nor anyone having occasion to pour babbitt will be without it. C. A. MARKLE.

Punxsutawney, Penn.

## A Planer Job on the Shaper

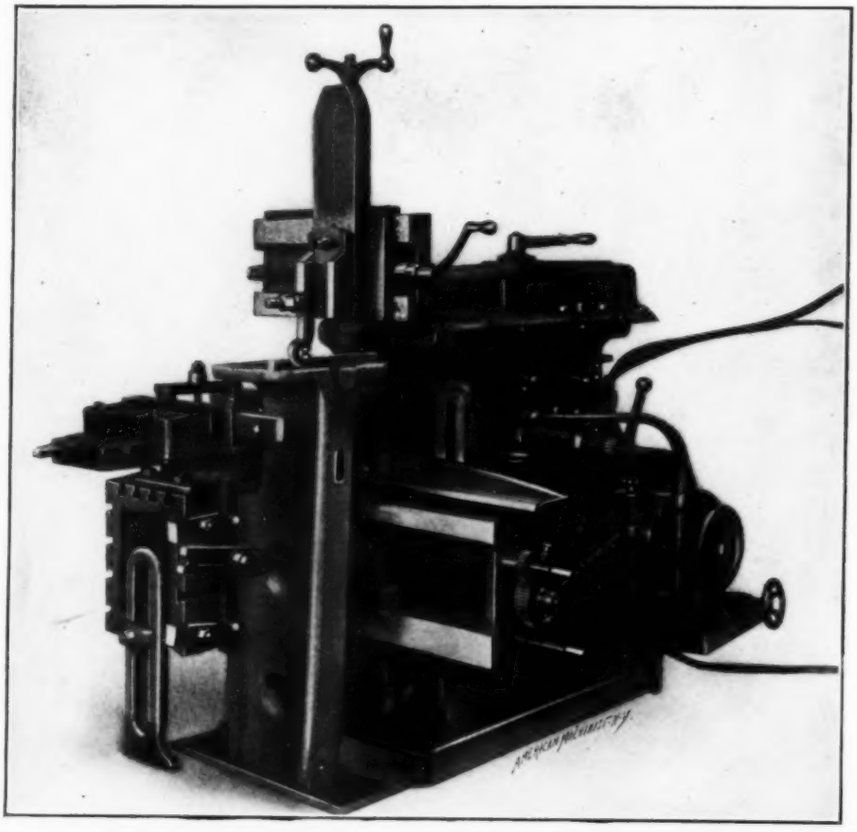
The accompanying halftone will no doubt prove of interest to some of your readers. The stunt was how to plane the ends of some long support castings, which would ordinarily require an open-side planer, or a planer with the housings set wide apart. All of our large planers had work enough ahead to keep them busy for several weeks, so the foreman figured that if he cut off the base of the shaper and got out a special tool head he could do the work all right, and was instructed to go ahead.

The shaper is an old-style Gould & Eberhardt, which was originally furnished with an extension base in front on which the outer support to the table traveled. We cut off this extension of the base, using a pneumatic chipper for the purpose, and then sunk a hole in the concrete flooring deep enough to accommodate the end of the casting, and lined the hole with wood. Care was taken in sinking this hole, to leave concrete enough on the one side to still use the outer support to the table, which proved of great benefit on account of the weight of the job.

We then figured that as the area to be planed on the casting was not very great, a special tool head with side traverse which we had on another shaper would be just the thing, and the exchange was accordingly made. This enabled our rigidly supporting the casting at the bottom of the hole, and by using straps in the regular T-slots in the side of the table, the whole job was held very rigid, and the work was turned out in very good shape.

An ideal gooseneck spring tool is shown in the toolpost. In forging this it is shaped by the blacksmith so that the cutting edge comes back of the center line of the tool, and, therefore, has a tendency to raise away from the work instead of gouging in should any hard spots be struck in the casting.

Newark, N. J. C. E. HOLGATE.



A PLANER JOB ON THE SHAPER

## A Motor Cycle Knife Grinding Outfit

The South Carolina man's use of his automobile for a portable farm power plant, described on page 624, is very ingenious, but I should imagine would be rather wearing on the engine parts. A fellow in this city also has a clever rig.

He belongs to the profession that has given us the handy expression "a tinker's dam" (a term frequently used in mechanics but not defined in the AMERICAN MACHINIST hand book), that is, he is a tinker and goes from house to house on repair work, the bulk of which consists in grinding knives and scissors. This man purchased the latest model motor cycle and attached his grinder to the front post. A belt, pulley and clutch connect it to the driving gear, so now instead of carting a grinder on his back, he can be seen steaming slowly along with the customary signal going. When a customer hails him he has only to drop the wheel support, get back on the seat and do the job. If business demands it, I expect to see him add a jewelers' lathe and possibly a drill press to his equipment.

RALPH W. DAVIS.

Rochester, N. Y.

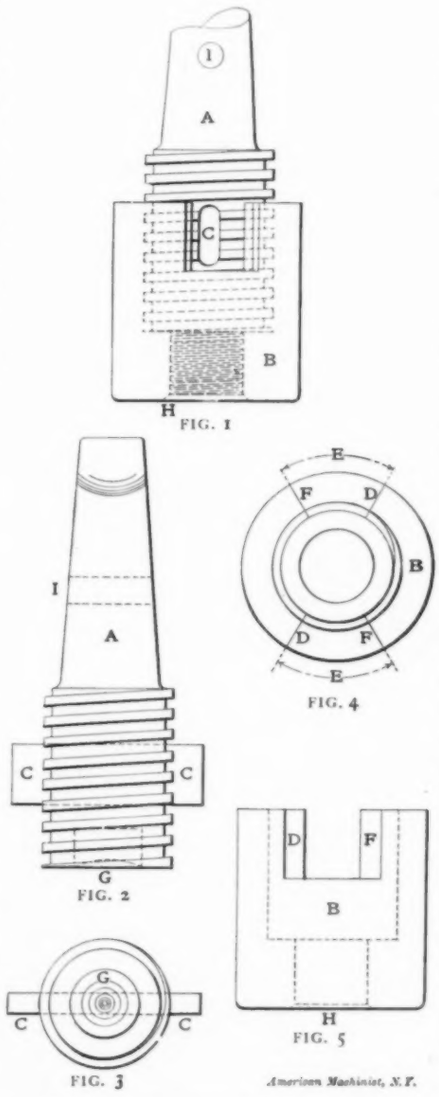
## A Power Stud Driver, with Automatic Release

It is surprising in these days of keen competition that so much stud driving is done by hand, and this after the holes have been machine tapped, where the studs could have been driven home in a fraction of the time it takes to do it by hand.

The cuts shown herewith illustrate a simple and efficient stud driver for the radial drill. It was made about eight years ago, has been in continuous use without the slightest mishap, and has saved its cost hundreds of times over. *A* is the steel Morse taper shank, fitting the spindle. It has a square thread, 3/8-inch lead, cut on the bottom, as shown. *B* is a case-hardened steel box for driving the studs home, shown also in Figs. 4 and 5, threaded on the top to be a nice easy fit on *A*. *C* is a case-hardened steel driving cotter, passing through *A*, which, under working conditions, drives *B* by coming in contact with the two milled faces *D D*, in Fig. 4. As soon as the stud is driven to the correct depth the machine is reversed, and the cotter swings through the arc *E*, coming up to the two faces *F F* and thereby raising the bottom end of *A*, about 1/16 inch clear of the end of the stud. This is an important feature, as there is no tendency whatever to slacken the stud back. *G* is a bronze piece driven tight into *A*, and cupped out slightly, as shown dotted in Fig. 2, which prevents marking or damaging the stud ends, while being driven. *H* is a recess at the bottom of the threaded hole for the stud, which makes the studs easy to enter while the machine is running. *I* is a pin hole in the shank to prevent the studder dropping out when feeding down.

In operation the machine is started, the stud being held in the hand and run into *B*. The spindle is then brought to position over the hole, and fed down by the lever to full depth. When reversed, the thread on the stud will shove the spindle up itself without the operator attending to it. Of course on a machine not fitted with a lever feed it would not be safe to use this studder, as it has no compensating device fitted to allow for a screw-feed spindle, and stripped threads would be the result, but all our machines are fitted with lever feed, so we have experienced no trouble in this respect.

Newcastle, England. J. CROSBY.




A POWER STUD DRIVER WITH AUTOMATIC RELEASE

## Worm Gearing Troubles and the Remedy

Two cases of worm driving have recenly come under my notice which I venture to think will prove interesting to your readers.

### FIRST CASE

A steel worm 11-inch pitch diameter, 2½-inch pitch, single thread, running at 250 revolutions per minute, driving a 70-tooth wheel, wore out the latter in 2 years. The wheel was cast iron and required 25 brake horsepower to drive under load. The machine only ran intermittently, say about 6 hours per day on the average. The worm is fixed at the bottom and lubricated with grease, both worm and wheel being covered to protect them from dust.

### SECOND CASE

A steel worm 6-inch pitch diameter, 2-inch pitch, single thread, running at 700 revolutions per minute, driving a 34-tooth wheel fitted with phosphor bronze rim, worm fixed at bottom and completely covered in with cast-iron case, the bottom half of wheel running in thick oil which is carried up to the worm by the wheel teeth.

The worm gets very hot after 45 minutes' run when the brake horsepower developed is 25 underload. So far as the writer can judge the pitch line velocity is too high and a better job, perhaps, would be made by introducing say a two or three to one reduction before the worms in both cases, with a corresponding increase in the leads of the worms, but on this point I would invite the opinion of your readers. Also what would be the increased end thrust on the worm shaft and how is it calculated?

Co Town, Ireland. J. WILSON.

[The fundamental defect in the design of these worms is that the pitch is too small in proportion to the diameter, that is, the pitch angle is too small. The speed is also high, although in the first case not much beyond recorded cases of successful practice with correctly designed worm gearing doing heavy duty. The rubbing speeds may be reduced and the pitch angles increased at the same time by reducing the diameters of the worms.

The correct principles of worm-gear design together with many examples from practice were published in these columns in 1898 and subsequently republished as No. 116 of Van Nostrand's Science Series, which is still in print.

Under these circumstances it is unnecessary to enter here upon an extended explanation of principles but in the case of the first worm, which, as it stands, is reasonably near success, it may be predicted with entire confidence that it would do the work successfully if the diameter

were reduced to 5 inches and the pitch increased to 5 inches—the worm being, of course, made with double threads.

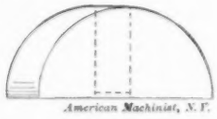
In the case of the second worm we cannot speak with absolute confidence as in the first case, but large improvement would be certain and entire success extremely probable if the pitch diameter were reduced to 3 inches and the pitch increased to the same figure—the thread being as in the first case made double.

In both cases it is contemplated that the speed in revolutions per minute shall remain as at present, although in the first case the speed might be safely increased to 350 revolutions per minute if the changes recommended are made. We are not informed of the uses to which these worms are put but in both cases a change in the gearing which drives the worm shaft will no doubt be necessary in order to deliver the proper speed.

Should our contributor make these changes we trust he will send us the results.—ED.]

## Gear Cutter Grinding Kink

To grind a gear-cutter by hand, that is to say without the necessary attachment, so that the tops of the teeth will continue equidistant from the center of the cutter is no easy matter, and it is necessary to have some quick and easy means of measuring to obtain good results. This can be done by measuring the distance from the face of the hole to the tops of the teeth by micrometer. This operation needs some care because the anvil of the micrometer makes only two points of contact with the face of the hole and to keep moving it around the hole in the process of measuring each tooth, is detrimental to the instrument. To obviate this I made an attachment, as in the sketch, to suit the hole in the cutter (which was one inch diameter in this case) and the anvil of the micrometer. I cut a piece of 1 inch cold rolled steel about ½ inch long, afterward sawing it through the center of the section, thus making two semi-circular pieces; one of these was faced true across




ATTACHMENT FOR MICROMETER FOR MEASURING GEAR CUTTER TEETH WHEN GRINDING

the diameter, also parallel with the horizontal line, taking care that the thickness of the piece and the thickness of the anvil end of the micrometer together measured not more than 1 inch. Using this face as a base, a hole was drilled about 0.002 inch larger than the diameter of the anvil of the 2-inch micrometer.

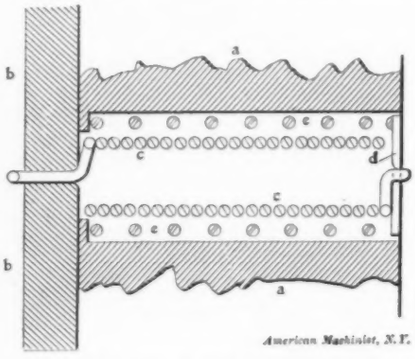
Obtaining a piece of drill-rod which would be a driving fit in this hole, one end was faced true and a piece cut off about 1/32 inch shorter than the length of the hole; this was pressed in, faced-end foremost, to within 1/32 inch of the base, thus leaving a recess. The other end was, of course, rounded off level with the curved surface. Slipped over the micrometer anvil the piece now forms a solid and effective measuring base.

Leicester, England. E. W. H.

## Spring Device for Limited Space

The accompanying cut illustrates a way in which a limited space for a spring may be made available for a greater separation between the parts connected than is generally considered advisable for any spring as commonly arranged with it, a movement of five inches being possible with only three inches of space for the spring.

A slide *a* is three inches long and has a movement of five inches. It abuts the stationary part *b* before it travels toward




A SPRING DEVICE FOR LIMITED SPACE

the right. The tension spring *c* is fast to *b* and is three inches long, its opposite end being fastened to the center of the plate *d*. This spring can be safely extended three inches. Over the spring *c* and abutting the outer edge of the plate *d* is an open or compression spring *e* whose opposite end is located against a flange in *a*. This spring is three inches open and will close down to one inch.

In operation the slide *a* goes to the right two inches before the spring *e* is compressed tightly against the flange *d*, whereupon spring *c*, which is stronger than *e*, will extend the remaining three inches to make the total of the five inches required. GEO. W. ARMSTRONG.

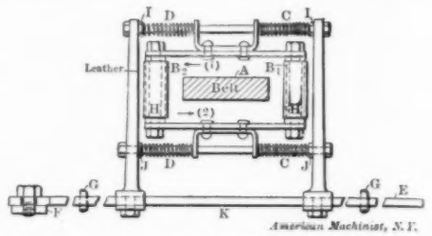
Norwich, Conn.

## A Belt Shifter

The disadvantages of the common fixed-finger belt shifters are well known; especially the injury done to the edges of belts by the rubbing action against the fingers, and particularly to cotton belts.

To remedy these defects a belt shifter shown by the accompanying engraving was devised. Referring to the engraving, *A* is the cross-section of the belt, $B_1$ $B_1$ are leather-covered rollers loosely fitting on spindles *H H* and free to turn on them. Springs are indicated by *C* and *D* whose tension can be regulated by the lock nuts *I* and *J*.

At *F* is a cross-section of the operating handle, fulcrumed below and connected to




A BELT SHIFTER

the sliding bar *K* which carries the shifter and slides in suitable guide pieces. At *G G* are the stop pins to limit the travel of the shifter.

When the belt is shifted, as shown by the arrow (1), the right-hand side of the belt touches the roller $B_1$ and as $B_1$ turns freely on its spindle the rubbing action on the belt is minimized. As the operation of shifting continues the springs *C C* are extended and the springs *D D* are compressed, the system is in balance and all jumping or vibrating of the belt is done away with. Thus the belt is shifted easily and smoothly. If the belt is shifted as shown by the arrow (2) the same effects are produced.

This shifter was designed by Mr. Famino and has been modified and used by me with good results.

A JAPANESE ENGINEER.

Tokio, Japan.

## Adjusting Slitting Saws to Prevent Breakage

When slitting metals with very thin circular saws it often happens that the saw sticks, and breaks sometimes with dire results to the job.

Here is a little kink which I have found excellent to prevent thin saws from breaking. In slitting, say a small spring chuck or similar work in the milling machine, I place the saw upon the arbor, to run in the same direction as the nut screws on.

Then by tightening the nut very lightly the saw may be pushed to its utmost efficiency; for if the saw should stick, the nut on the arbor will simply come loose and allow the saw to slip between the collars.

With a little practice the nut can be adjusted to a nicety either with the hand, as in the case of extremely thin saws, or with a wrench for saws which are a little heavier. This is a matter of judgment for the one using the saw.

New York. L. W. CHARLES.

# Discussion of the Previous Question

## Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

## WE PAY FOR THESE ALSO

### Old Machine Tools

I have just read with much interest Mr. Dixie's article on the Phoenix Iron Works, on page 1010, Part 1, Volume 32, and it brings very vividly to mind my early days. There are several things in this article wherein I think Mr. Dixie has been misled.

First, mention is made of Samuel Colt as reputed to have been the first to make revolvers with interchangeable parts. This may be true so far as revolvers are concerned, but guns and pistols were made with interchangeable parts before this time by Whitney of New Haven, and Simeon North of Middletown, Conn. Before the milling machine came into being, duplication was obtained by jig filing. The filing jig is supposed to be the invention of Selah North, a son of Simeon North.

As to the origin of the milling machine I have heard that question discussed many times years ago, and have always understood it lay between the Whitney shops at New Haven and the North shops at Middletown. As a boy with something of a mechanical turn I took as much pleasure in being around shops as I did in the usual boy's pastime. I frequently spent the whole of the Saturday half holiday in those shops. My father was employed there. I distinctly remember the milling machines in the North shops as early as 1850. I have in my possession a breech-loading gun made by Simeon North in 1849, one piece of which required no subsequent finish after the milling. The piece plainly shows the cutter marks. I also have a pistol made by North in 1827. This compares somewhat unfavorably as to workmanship with the gun.

Now as to the Robbins & Lawrence idea of running cutters in a lathe with fixtures on a slide rest, if they ever had such an idea they abandoned it before they moved to Hartford in 1852-3. My father was one of the first employees at the Robbins & Lawrence Hartford works, and much of my time as a boy was spent around these shops. Shops were easier of access then than today. There were plenty of milling machines there for those days.

In 1861 I went to work at the Sharp shops running milling machines. One of the machines I ran had been slightly altered to adapt it to a special cut. In the early 80's, having started business on my own account, I found myself in need of a milling machine. Cash was a scarce article, no great accuracy was required, and I naturally looked around for something cheap. By mere chance I ran across, among a lot of second-hand junk, this identical machine which I had run as a boy; recognizable by the early alteration. We still have this machine, and today since reading the article by Mr. Dixie I went into the factory and on the machine found the name plate which is shown in the accompanying half-tone. The machine is so located it cannot very well be photographed, and alterations have been made so it does not look just like the original. This machine is still in service, and gets along very well on some classes of work. Robbins & Lawrence moved to Hartford in 1852-3, and, while the shops there were building, kept the Windsor shops running (they were already building the Sharp's rifle at Windsor) until the Hartford shops were complete and ready

NAME PLATE FROM OLD MILLING MACHINE

to move into, which no doubt accounts for the date on the name plate.

I think this disproves the idea that the milling machine as designed by Pratt was inspired by the idea of doing milling on a lathe. Everyone familiar with the birth of the Lincoln machine understood it to be an improvement on the Robbins & Lawrence machine, and it was certainly a decided improvement. Many Lincoln machines were in use at the Sharp shops when I worked there. They were, as Fig. 2 on page 1011 shows, substantially as built today, except as to weight. The great improvement on the Robbins & Lawrence machine was in the feed of the carriage. The Robbins & Lawrence machine had a rack and pinion feed, and in starting a cut of any depth it was necessary to hold back on the handwheel of the pinion shaft, after the feed was thrown in, until the cut was well started; the chatter being such that one might expect to see it turn turtle.

We also had a milling machine at the Sharp shops called the Baldwin machine. Just where it got its name I never knew. It was designed by one Howe who was employed by Robbins & Lawrence at Windsor; and was built there, certainly, as early as '53. In those days we badly needed something which would cut a spiral-toothed milling cutter. This machine was so constructed that a pair of index centers held in the vise of the machine could be elevated at one end and depressed at the other; and swung around at an angle with the spindle, so as to get an oblique cut on the blank. This gave us a cutter in which the entire length of tooth did not strike the work at once. There was, of course, just one point in the cutter where the tooth was correct in shape, but it was much better than a straight tooth. There was weight enough in this machine to make three or four Brown & Sharpe universals, which came on the market about this time.

The index machine, Fig. 11, page 1010, was a good tool, and there are many things done today on modern machines which could be done just as well and quickly on this machine. I wish I had just such a machine. I am quite sure this machine had its origin in the Robbins & Lawrence Windsor shops, in substantially the same design as illustrated, and not in the Lincoln shops, as might be inferred from Mr. Dixie's article. The machine as built by Lincoln was stronger and heavier, and on somewhat different lines from those built in Windsor, the frame especially being of better design and much heavier. These machines were also built at the Sharp works in Hartford during the early 60's.

Robbins & Lawrence also built a multiple-spindle drill at the Windsor shops, and later they were built at Sharp's in Hartford; also identical with the cut, Fig. 8, page 1012. Some were built with two gangs of spindles on a single column, thus economizing room. This was the design of Mr. Lawrence.

The lathe, Fig. 14, page 1013, was in use at the Sharp works in Hartford, and we all considered it ahead of anything of its kind.

If someone would take the time to hunt up the old men who are still left in such places as Windsor, Hartford, New Haven, and many other of the early manufacturing centers of the New England States, I think he could find plenty of material for a good-sized and very interesting volume regarding what was done there years ago.

G. MAKERS.

Philadelphia, Penn.

# Should Screw Threads Have a 60-degree Angle at Right Angles to the Helix?

Referring to the article by L. E. Dudley on page 1045, Volume 32, Part 1, I would say that his criticism of existing conditions in the production of threaded work of comparative accuracy, deserves more than passing notice.

Before the introduction of the thread-milling machine, with its form cutter swiveled at an angle to correspond to the angle of the helix, many concerns engaged in the making of accurate-threaded parts, admitted the necessity of making their thread tools so that when the thread was completed on the work in process it would make an included angle of 60 degrees, at right angles to the axis of the part threaded. However, since the introduction and almost universal use of the thread-milling machine, the question of producing threaded forms which shall be interchangeable and of the correct form has come up and is yet to be decided.

In the use of the thread-milling machine, the angles produced instead of having the sides as a straight surface, come from the machine with sides of curved outline and the cutter will not duplicate its exact form, as the correct angle of the thread is measured at right angles to the axis and not at right angles to the angle of the helix of the thread as the cutter is set. Now we will consider this principle applied to the threading of gages. In the first place, the making of reference gages will not permit the employment of the thread-milling machine except in the process of roughing out the thread, so that when it comes to the finishing, the single-point tool will have a minimum amount of stock to remove, thereby increasing the life of the tool and keeping it in a better condition for accurate work.

From the foregoing, it is seen that the production of reference thread gages can only be accomplished by the finishing of the thread with a single-point tool, made and accurately ground with allowance on the angle to compensate for the clearance necessary for its use.

Mr. Dudley says that their arrangements are all made to measure at right angles to the helix or at an angle to the axis equal to the angle of the lead of the thread. This procedure must take an elaborate and expensive equipment for we know that every different pitch applied to every different diameter will produce a change in the angle of such a thread when measured at right angles to the helix or at an angle to the axis equal to the angle of the lead of the thread being cut.

At the factory of Wells Brothers' Company, Greenfield, Mass., has been adopted the device shown in Fig. 1, as a solution of the measuring problem, and the results obtained have more than justified its adoption. By careful inspection of Fig. 1, it will be seen that the means provided for measuring the thread is by a micrometer having two steel points, each of which is ground and lapped to exactly 60 degrees included angle; these points enter the thread diametrically opposite each other and by having the point *a* carried by a bar which moves at right angles to the center line of the spindle *b*, we can thus obtain a move-

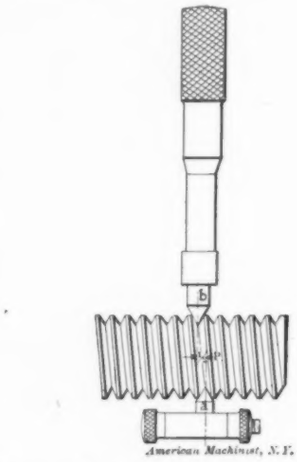



FIG. 1. MICROMETER IN POSITION TO MEASURE THREAD

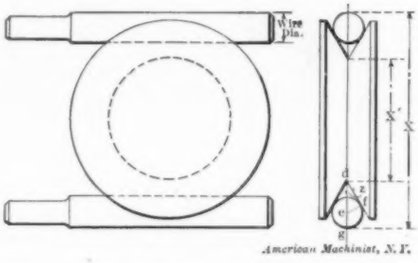



FIG. 2. REFERENCE DISK USED TO SET THREAD MICROMETER

ment equal to one-half of the pitch of the thread being cut and thus permit the points to enter at right angles to the axis of the screw or gage. The original setting of this micrometer is maintained by reference to a standard setting plug which is used only for reference. To show the method of measurement, let us observe Fig. 2, which is a drawing of the plug used to maintain the micrometer at the standard size. This plug is very carefully made, and in finishing the angle, a cut is made on one side at an angle of 3 degrees from a right angle with the axis, the work is then turned end for end and a cut made on the other side, thus insuring that the included angle will be equal on each side of the center. In the first place, let us test the disk by the use of wires, which method is in use more or less in the majority of factories. We will take our standard disk and place in the groove, on opposite sides, two wires each with an equal diameter and very carefully lapped so as to be parallel the entire length and finally verified on a reliable measuring machine. Now placing our disk with its two wires in the angle of the groove, onto the supporting stand of the measuring machine, we bring the contact points up to touch the wires and take our reading. This reading will be $X$ in Fig. 2. With this reading as a base, our object will now be to find the reading at $X$, which is obtained as follows:

The angle $d\ f\ e$ is a right-angle triangle with an angle $Z$ of 30 degrees, and the opposite side, $e\ f$ equal to one-half the diameter of the wire. Having given the angle $Z$ and the side $e\ f$, to find the side $e\ d$.

Now,

$$e\,d = \frac{e\,f}{\sin.\ angle\ Z},$$

and $e\ d + e\ g = g\ d =$ the distance from vertex of angle to the outside diameter of the wire, and adding a distance $g\ d$ for the opposite side, we subtract this total sum from $X$ which will give us the measurement at $X$ in Fig. 2.

This method of thread measurement will give us the following formula for United States form of threads, where

$D =$ Nominal diameter of gage or screw,

$X =$ Measurement on micrometer,

$C =$ Constant to be subtracted from nominal diameter to obtain $X$,

$N =$ Number of threads per inch,

$$C = \frac{1.5155}{N},$$

and

$$X = D - C \text{ or } - D\left(\frac{1.5155}{N}\right).$$

Coming back to our subject in regard to the use of the thread-milling machines or any method which permits the use of a swiveling tool, in the production of reference gages, we see that imperfect results only are obtained and to overcome this I would suggest the use of limit plug-thread gages, following out the lines of the American Society of Mechanical Engineers' report for the machine-screw standard, for we all realize the impossibility of maintaining the size of tapped or threaded work to gages wherein there is no limit and it seems much better that gages, defining this limit, made with practical accuracy, with the limits definitely determined, should be placed in the hands of the operators, than to continue the use of expensive gages after they have become slightly worn.

Owing to a lack of definite data on the effect of the thread-milling machine in the accurate production of gages, I have under consideration a series of experiments tending to show accurately the results produced by its use, and expect to present them to your readers at an early date.

F. CHARLES SCRIBNER.

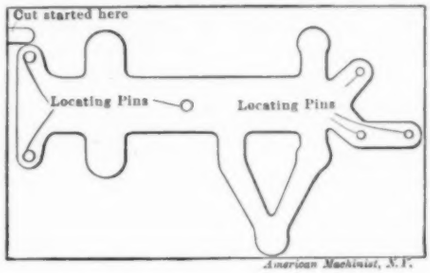
Greenfield, Mass.

## Results from a Templet Cutting Machine

On page 870, Vol. 31, Part 2, you described a templet-cutting machine by Ph. Bonvillian & E. Ronceray. The article was very interesting to us inasmuch as we have had one of the machines for about a year. The primary object of this machine, we understand, was to facilitate the cutting of sweeps and templets for foundry use, the cutting being done to lines. This we have found to be entirely unsatisfactory, as the chances of running over the line and spoiling a layout requiring from one to three hours' time were too great.

Herewith is a sketch of a piece of work, Fig. 1, which we have done very satisfactorily on this machine and the method of which I will describe. The machine we are using is a No. 1 size, which will run at 500 revolutions per minute; just twice the speed designated for this machine in the manufacturer's catalog. This speed enables us to do much better work and a great deal more of it with less wear on our punch and die. In this class of work where many parts are made of sheet metal and required to be finished in given sizes and where the making of temporary dies would be entirely too expensive, we have found this stunt to work out exceedingly well and much quicker than any other way we could devise.

The first step in using this machine is to make a master templet 3/16 of an inch thick of machine steel so that the cutting edge of the punch will not come above the top of the master templet. The master when finished should be carbonized, which we have found to be the best process as the variation in dimensions, due to hardening, are slight and 90 per cent. of our master templets are correct within our limit of 0.0005 of an inch after hardening. This is done so that our punch working up and down against the face of the master templet will not have a tendency to swage the metal and change the shape. We then drill the holes in the pieces to be cut out and drive locating pins through the master into these holes, and by setting the punch in the machine at a slight angle to the work it has a tendency to cut close to the master—so close in fact, as to leave barely enough to file when the punch is working properly. The punches, which cost but a few cents apiece to make, are thrown away when dull and the die is taken from the machine and reground. The time consumed in cutting out 100 pieces, as shown in the sketch, averaged five minutes each, saving in time being about $1 for each piece. It may seem that this statement is exaggerated, but when we take into consideration the fact that we cut so closely to the form that it took but five minutes' work on the filing machine to finish these pieces, you can readily see the advantage over the old method of drilling and then filing off the surplus stock. In addition to using the machine for "chopping" out parts, it does all the cutting off of sheet metal and saves 90 per cent. of the number of hack-saw blades formerly used, and about the same amount of time fomerly consumed in cutting off stock. The machine is located near the stock




MASTER TEMPLET, BLANK AND START OF CUT ON TEMPLET FORMING MACHINE

rack and the workman can select stock, cut it off and be back to his bench in the same time it would take to carry back the extra stock. Another advantage is that the workmen like to use this machine because it saves them the disagreeable hack-saw work and their temper at the same time.

While the mechanical work done on the construction of this machine is not good, yet it is a wonderful time and labor saver, and we feel that anyone doing experimental work where a number of duplicate parts are required, or in small shops doing novelty work it will be found a wonderful adjunct to the equipment.

H. P. Anderson.

Dayton, Ohio.

## What is a Good Running Fit?

On page 75 Mr. Sangster has given some very interesting data from makers of various lines of machinery regarding running fits. Against this I will cite a few running fits that have been in my line.

Take the connecting rod of a horizontal engine. It is well known that engineers, as a rule, make a fit of their own kind if they have a knock on any part of their engines. How much allowance is there between brasses and crank pin? Answering this I should say about 0.004 inch. Generally the taper on the keys is ¾ inch to 1 foot. This is the way a good many engineers get their running fit. They first put a slight coating of red lead over the pin, then assemble the rod and brasses; next they drive up the key fairly tight. The rod is then lifted up and down and the brasses scraped until there is a bearing all around. The brasses are then relieved about one-sixth of the circumference top and bottom and cleaned off. The rod is again assembled ready to run and the key again driven in tight; after marking a line with a scratch awl the key is loosened back about 1/16 inch. If lubricated in a proper manner no trouble will be had.

Now we will take an induction motor, say about 50 horsepower, with a shaft diameter of 2½ inches. The gap between the armature and fields is about 0.024 inch. The bearings must surely have considerably less than this, or after running a very short time there would be a miniature Fourth of July. Here, again, is shown the importance of good oiling.

On loose pulleys I have experimented with one having a bore of 2 15/16 inches. We have bored the pulley out a very close fit to the shaft, having to pull them around the shaft to get them in position. I have had the oil grooves cut spirally the way the pulley ran and again the oil grooves cut straight across the bore. The spiral oil-grooved pulleys have proved the best by a good margin, never giving any trouble. I have had brass-bushed pulleys on 3 15/16-inch shafts bored out 0.004 inch larger than the shaft with oil grooves cut spirally, which gave no trouble; then again, I have others bored out the same size with straight oil grooves, and instead of one bushing there were two with a space between to act as an oil reservoir. At times we would have these heat up and stick, throwing the belt off.

Three years ago we had occasion to babbitt a 180-horsepower Dodge friction-pulley sleeve 4 15/16 inches bore, 3 feet 6 inches long. We babbitted it to a piece of its own shaft and after cooling merely scraped it to fit. Out of curiosity I measured it and found it varied from 0.003 to 0.005 inch. Up to the present I have not heard any complaint from the oiler. I presume if I measured it now I would find about 0.125 inch difference in size. After babbitting we cut extra large grooves straight across as this pulley had three compression grease cups instead of oil. This pulley is attended to every noontime.

Now for a 36-inch lathe (a curiosity again). After turning off a large roll and noticing no vibration I took a wrench and tried the screws on the spindle bearings and found that they were down tight, proving that the brasses were locked together. After the job was finished I took off the caps, removed the spindle, then replaced the caps, and on measuring them I found the bearing near the carriage 0.006 inch larger than the spindle, this being 4¼ inches diameter; on the other end the diameter was 3½ inches and bearing 0.004 inch larger. In conclusion, I will say from my experience as close a fit as possible is best if proper lubrication is assured, and for all high-speed bearings and pulleys make provision so that oil can be fed to the extreme end of the bearing.

George H. Handley.

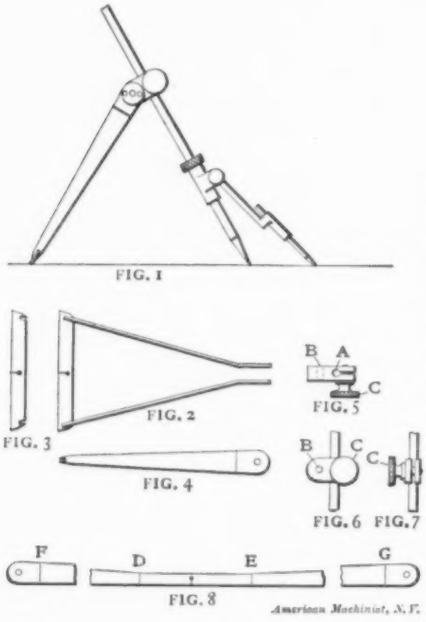
Newburgh, N. Y.

## A Compass for Drawing Ellipses

The instrument for this purpose shown by S. J. P. at page 940, Voulme 32, Part 1, is quite interesting, but perhaps the modifications shown herewith might improve it.

If the back leg, or the leg that does not represent the incline axis of the cylinder, is made triangular instead of with a point as S. J. P. shows it, the lower side of the triangle being parallel to the pivot of the compass legs, this feature will insure that the axis leg stands in a plane at right angles with the paper, and incidentally that the instrument will stand alone.

Fig. 2 shows the back leg, and Fig. 3 shows the lower bar of this triangular framework before joining to the other two sides, while Fig. 4 shows one of the




A COMPASS FOR DRAWING ELLIPSES

long sides of the triangle before joining. The back leg could be made of three pieces of sheet metal notched at the ends, as shown, and brazed together, or even soft solder might answer if the instrument was carefully used. The mark shown at the midlength of the lower bar is to be brought to coincide with the major axis produced, and is analogous to the point of the back leg as shown by S. J. P. In constructing the instrument it would be best to make this mark after the instrument was completed, by folding the legs together and making the mark where the axis leg struck the lower bar, the bar being marked on both sides.

Figs. 5, 6 and 7 show three views of a block that is offered as a suggestion for a joint for the legs of an instrument of this kind. The hole *B* is for the pivot of the back leg, while the axis leg is clamped in the hole *A* by the screw *C*. The axis leg is merely a straight round rod with a point at its lower end, and may be clamped at any point in the pivot block, as it is not necessary that both legs should be of the same length. This construction also admits of the axis leg being removed and easily placed in the lathe for truing the point in case it should get damaged, as the rod got bent.

Fig. 8 shows another construction of the back leg, where it is made all in one piece, and bent at the points *D*, *E*, *F* and *G*. Should it be desired to place a weight in the open part of the triangle to hold the instrument steady while drawing the ellipse, then Fig. 2 would be a better construction than Fig. 8, as in the former case the weight would tend to hold down the point of the axis leg, while if made as in Fig. 8, the weight would tend to lift this point, and thus defeat the object sought.

WALTER GRIBBEN.

Brooklyn, N. Y.

## Steel after Quenching

E. W. Harris, on page 899, Part 1 of Volume 32, mentions a case of peculiarity he came across when case-hardening a 2-inch mandrel turned from bar steel and packed with a number of others. This particular one proved to be not hard after quenching. Repeated heating and quenching in the usual way were without any better results, whereas the annealing of this particular piece produced the required hardness. This fact is very astonishing, as it is contrary to all practice and experience.

I am convinced that the mystery mentioned will soon disappear if Mr. Harris will try the mandrel in question with the spark method when grinding steels. The sparks of this mandrel will prove that it was turned by mistake from a bar of high-speed steel or self-hardening steel instead of carbon steel. By experience I have found that self-hardening and high-speed steels become very soft when quenched from a red heat in water at 65 to 70 degrees Fahrenheit, or cooled in other baths either slowly or quickly.

As the above mentioned mandrel became hard by quenching it at the annealing temperature, it is evident that in this case this temperature was superior to the softening temperature of this particular steel, which, therefore, cannot be else than self-hardening or high-speed steel.

You may find the softening temperature of any steel by quenching it at different temperatures in water of, say 65 to 70 degrees Fahrenheit, and the temperature at which it becomes soft may be marked as the softening temperature.

In everyday practice, however, when handling high-speed steels the softening may be done by cooling the steel at the softening temperature in any way except by quenching in water. My investigations in this matter proved that this cooling destroys the capacity of the high-speed steel to be hardened. In softening high-speed steels they also proved to me that the softening (annealing) of this kind of steels depends only and solely upon the peculiar temperature and not at all upon the time the annealing lasts. These facts are, as far as I know, unknown yet, and may be very useful.

MAX BURMANN.

Budapest, Hungary.

## Hot Saw as Cut-off Machine

I have read with considerable interest H. Terhune's article, on page 977, Part 2, Volume 32, entitled "The Hot Saw as a Cutoff Machine." I have had some interesting experiences with both hot saws and cutoff machines, and in the use of the former for doing the work of the latter. I have, however, not had a hot saw running at more than 1500 revolutions per minute, and this perhaps accounts for the fact that when cutting cold stuff the saw suffered considerably and required frequent regrinding.

The saws are about 30 inches diameter, somewhat larger than those used by Mr. Terhune, and the difference in peripheral speed would be somewhere near 5500 feet, or a mile, a minute. I found that at the higher speed the condition of the saw was not impaired to such an extent as at the lower speeds. But for various reasons the saw could not be run at a higher speed than 1500 revolutions, so I was unable to experiment further in that direction.

I found that the bur raised in cutting cold stuff with the hot saw was very considerable, and was difficult to remove. This trouble of removing the bur from the work was so great with the cutting-off machine proper, that it was one of the factors leading to the abandonment of the machine. The deafening noise, and the inability to get men to stick to the job very long were other factors, and consequently we do all the cutting at the hot saw after reheating in a furnace.

Latterly, however, the oxy-acetylene apparatus has been tried and judging from the results obtained, looks like supplanting both machines for this work.

Sheffield, England. M. C. CONAN.

The largest electrically controlled switch tower in the world has just been put into service at Providence, R. I., on the New York, New Haven & Hartford Railroad, according to the *Scientific American*. The tower is equipped with 77 switch levers, providing 266 combinations. Elaborate precautions are furnished to prevent the giving of a wrong signal. The power used is taken from the feed wires of the railway, but as a precaution two other sources of power are provided, which may be drawn upon in case of emergency.

# AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

*CIRCULATION STATEMENT*

*During* 1908 *we printed and circulated* 1,205,750 *copies of the* AMERICAN MACHINIST. *Our circulation for July,* 1909, *was (weekly, monthly and European)* 110,000.

*August* 5..... 35,750
*August* 12..... 19,750

*This paper reaches* 35,750 *separate readers each month and* 19,750 *each week.*

*None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.*


## Contents


| | PAGE |
|---|---|
| The Machine Has Taken Away the Job | 265 |
| Protractor Attachment for Measuring Angle of File Teeth | 271 |
| Machine Control and Levers | 272 |
| Machine-cut Double-helical Gears | 273 |
| Testing Gasolene Engines with a Fan Brake | 277 |
| Automatic Railroad Protection | 278 |
| Indexing Chuck for the Turret Lathe | 285 |
| The Machinery Trade of the United Kingdom | 286 |
| Practical Letters from Our Readers: Boring Fixtures for Bench Lathe Heads....Asbestos for Babbitting ....A Planer Job on the Shaper.... A Motor Cycle Knife Grinding Outfit....A Power Stud Driver.... Worm Gearing Troubles .... Gear Cutter Grinding Kink .... Spring Device for Limited Space....A Belt Shifter....Adjusting Slitting Saws to Prevent Breakage | 287-290 |
| Discussion of the Previous Question: Old Machine Tools....Angle of Screw Threads....Results from a Templet Cutting Machine....What Is a Good Running Fit?....A Compass for Drawing Ellipses .... Steel After Quenching....Hot Saw as Cutoff Machine | 291-294 |
| Providing and Using Safety Appliances | 295 |
| New Tools and Machine Shop Appliances | 296 |


## Providing and Using Safety Appliances

The question of accidents in the shop and of ways in which they can be prevented or even lessened, is always of interest. To the worker whose life is endangered (with its attendant hardship to his family to have the bread-winner removed, or, worse yet, to have him crippled so as to not only fail to support, but to be a burden on them), it is a vital problem. He, above all others, should welcome any change or safeguard that will lessen the dangers, and yet we too often find cases where he deliberately neglects them, refusing to use them when provided.

A recent instance of this was in a shop where a planer hand had narrowly escaped death when his helper accidentally moved the starting lever at the side. The firm immediately put on a safety lock that would effectually prevent this occurring again, and in less than a week after it happened the man was again risking his life in exactly the same way, neglecting to use the safety lock which had been provided.

There are cases where some excuse may exist for "taking chances" like this, such as the use of the so-called safety device materially reducing a man's output and consequently his wages, and, in fact, many cases of apparent neglect are directly traceable to this. Few men put themselves in danger purposely without some impelling motive, but here was a case where no reason, save carelessness or habit, could be given.

In some parts of the country a very strict inspection of factories is being made and much good has resulted, although much depends on the individuality of the inspector. The death-dealing, unprotected set screw is becoming less common, but still exists in too many shops where you would hardly expect to find it.

There seems to be a growing tendency in many localities to divide the responsibility for accidents by holding the employer who fails to provide a safety appliance and to hold the workman who fails to use one after it is provided. The State of Wisconsin is very strict in this matter, especially in Milwaukee, where there are numerous instances of workmen being arrested and fined for failing to use a safety appliance that had been ordered by the inspector and provided by the employer.

It would seem safe to say that no man wants to be injured, and yet we see them taking risks that are intensely unnecessary in too many cases. Nor is it easy to believe that any employer looks with indifference upon the injury of his men. Yet we see the menacing set screw and have the testimony of a coroner in Pittsburg that a large concern there was only brought to a sense of duty by continued arrest as witnesses in cases of violent deaths. The same statement asserts that since this has been done the fatal accidents have been reduced 65 per cent. in these shops, showing that an almost unbelievable indifference to human suffering must have existed before.

While some men are careless about using safety appliances, this hardly forms an excuse for not adopting them, and as long as such flagrant examples of apparent indifference as that of the Pittsburg shop cited, or of projecting set screws, unguarded gears and belts, etc., exist, such employers cannot well place all the blame on the other side, nor wonder that the men feel they are looked on as part of the machine equipment with little thought for health or safety.

Fortunately for all concerned, these cases are exceptional and the tendency toward better protection for the workmen is shown in the growing use of guarded gears as a part of the regular equipment of lathes and other tools. There is room for improvement on both sides and, as in most other problems, the best results are sure to be obtained by a careful coöperation between the employer and his men. It would even seem better for all concerned to discharge a man who would not use a safety appliance, on account of its effect on the rest of the shop, but we do not believe this will often be necessary if they are assured that they are installed to be used, and not to comply with or to evade the law.

---

It is claimed in England that William Murdoch was the first to extract gas from coal and to apply it for lighting purposes. The French have put in a claim on behalf of their fellow countryman, Philippe Lebon, but it is admitted that whereas Murdoch's discovery was made in 1792, Lebon did not discover coal gas until three years later. The Belgians, on the other hand, according to *The Engineer*, have, by the recent researches of M. Boghaert Vache, established that coal gas was in reality discovered in 1783 by Jean Pierre Minckelers, a Belgian physician. It seems to have come about in this wise: The Duke of Arenberg, who was an enthusiastic balloonist, requested three professors of the university of Louvain to find a gas lighter than hot air and less costly than hydrogen. Professor Minckelers was one of the scientists employed, and he had the good luck to extract the gas wanted from coal. In the middle of November of 1783 the first balloon inflated by coal gas ascended from the park of the castle of Arenberg, at Heverle, near Louvain, and this important event has just been commemorated by the commune of Heverle by a balloon festival under the auspices of the Belgian Aëro Club.

# New Tools and Machine Shop Appliances

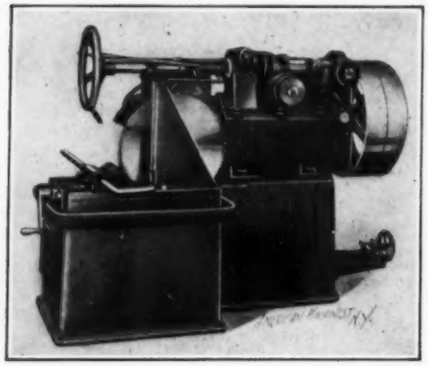
## Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

## THE LATEST INFORMATION

### A Portable Jib Crane

This crane (see accompanying cut) consists of a heavy base plate, a structural steel pillar attached thereto and a swivel plate on top on which a rotating jib is pivoted. A movable trolley is provided which supports a block and hook. A weight attached to the opposite end of the jib balances the trolley and part of the load. The jib is stayed by tension rods for the strut, which contains eyebolts for the clevis loop by which the crane is lifted and transported by the overhead traveler.

The hoisting gearing is attached to the base plate or structural pillar and is operated by pneumatic or electric motor or hand power. The swinging and trolley travel are operated by hand power. The capacity range is from 1000 pounds to two tons, with an effective radius of about 10 feet. These cranes are manufactured by Whiting Foundry Equipment Company, Harvey, Ill.



A PORTABLE JIB CRANE

### "Rapid" Cold Saws—Models D and E

The firm of Gustav Wagner, Maschinenfabrik, Reutlingen, Germany, has recently placed on the market a line of cold saws designated as "Rapid"; see the accompanying illustrations.



FIG. 1. RAPID COLD SAW MODEL D

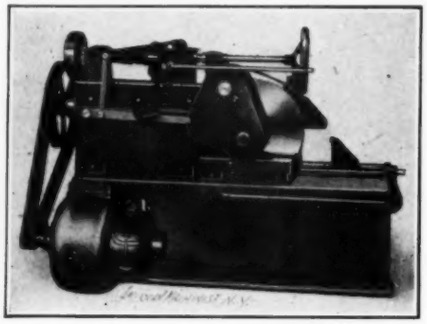


FIG. 2. RAPID COLD SAW MODEL E

The frame is of the box type carrying a heavy head stock, the cutter slide and clamping devices.

The drive is powerful and is through double right- and left-hand spiral gears, whereby the end thrust of the shafts is completely taken up and the pressure on the teeth of the spiral gears is substantially reduced.

The feed is through stepped cones, a worm and worm gear and can be adapted to the material and section to be cut; there is an automatic trip at the end of the cut. The slide is supported for its entire length as shown in Fig. 2. Thus vibrations are prevented.

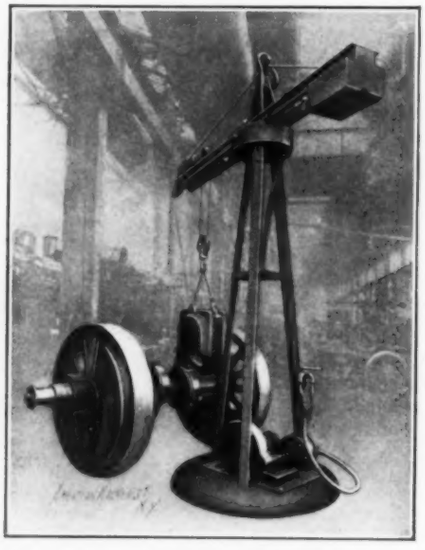
A pump supplies lubricant for cooling and lubricating the saw blade. This blade has inserted teeth of high-speed steel. The cutting-off time for Siemens-Martin steel, No. 3 hardness, is one minute for a diameter of 4 inches, two minutes for a diameter of 6 inches and four minutes for a diameter of 8 inches.

The Model D machine is arranged for belt drive, has a saw blade 20 inches in diameter and a capacity for round stock up to 6 inches in diameter. The model E machine is arranged for motor drive; has a saw blade 26 inches in diameter and has a capacity in round stock up to 8 inches in diameter.

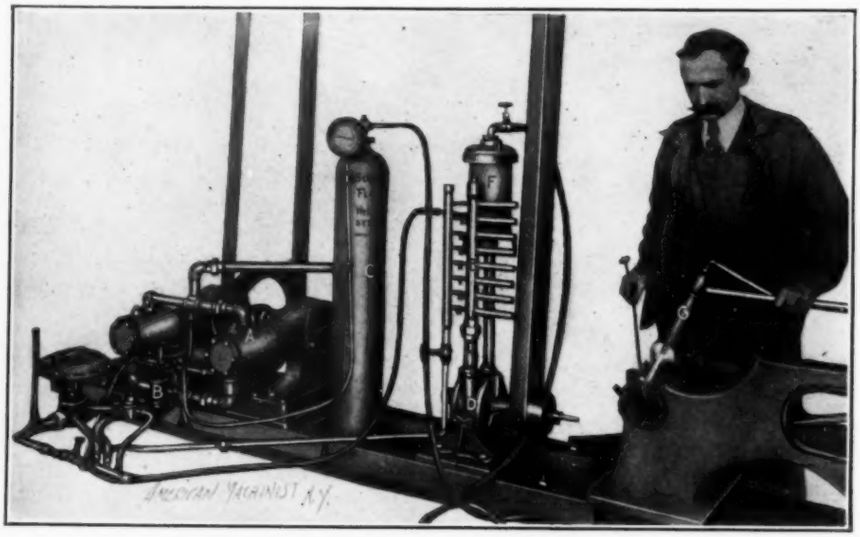
### Schaap Flame Welding Outfit

The apparatus shown in the accompanying halftone was designed for the purpose of fusion-welding cast iron, aluminum, or the nonferrous metals, with illuminating gas in the form of natural gas or manufactured city gas. It is manufactured by the Schaap Flame Utilities Corporation, 344 Cumberland street, Brooklyn, N. Y.

The apparatus consists of the air compressor *A* that takes a mixture of gas and air at *B* and compresses it in the steel



A PORTABLE JIB CRANE



APPARATUS FOR FUSION WELDING WITH ILLUMINATING GAS

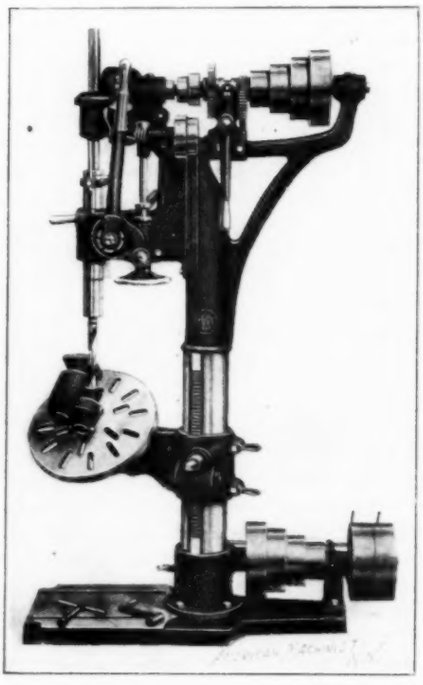
bottle *C* under a pressure of from 100 to 150 pounds per square inch. Working in conjunction with this is the small air compressor *D* that takes gas and air through the pipes at *E* and compresses it in the tank *F* under a pressure from 1½ to 2 pounds per square inch. These two mixtures are conducted to the torch *G* by rubber pipes.

The mixture of gas and air under high pressure, from the tank *C*, is sent through the tip in the center of the torch and generates heat enough to melt and fusion-weld cast iron. The mixture of gas and air, under low pressure, in the tank *F* is sent through the openings of the torch that surround the central nozzle and these keep the high-pressure jet in the center lit, as well as protecting it from the outside atmosphere.

The torch is composed of five tubes, one inside of the other, with a space between each for the low-pressure gas to come through and burn. In the center of these is a high-pressure gas tube, and this is threaded on the end so different-sized nozzles can be used. With the torch as sold, four different-sized nozzles are supplied, three of which are used for fusion-welding and one for brazing. Any number of nozzles can be used, however, to suit the work in hand by simply drilling different-sized holes in the end of each. The cost of the gas used with this torch is very small, and no fluxes are used when welding cast iron or aluminum.

## Drill Press with Universal Table

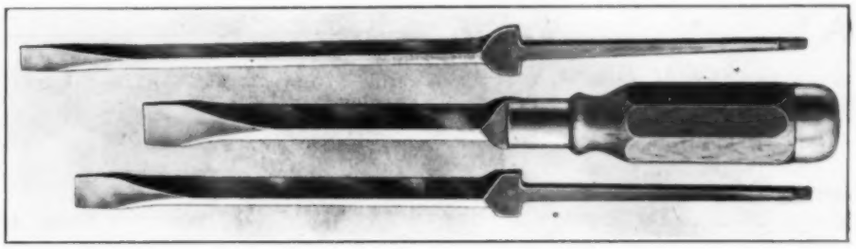
The illustration shows a new universal or tilting table which is now being supplied by the Robertson Drill and Tool Company, 1848 Niagara street, Buffalo, N. Y., with their 21-inch drill press. A gas-engine cylinder is shown clamped to the table which has been swung at the desired position so as to drill a side outlet at the proper angle. The table can be swung into a vertical position and can then be turned on its center bearing so as to bring any desired portion of the work under the drill. As there is almost no limit to the way in which the work can be held for drilling, many different uses for it will be found in almost every shop.



DRILL WITH UNIVERSAL TABLE

## Substantial Screwdriver

There are few things more annoying than to have a screwdriver with a loose or weak handle and those who have much erecting to do where machine screws are used will appreciate the construction shown in the accompanying illustration. This needs little, if any, explanation and shows a screwdriver set being manufactured by the Lynn Tool Forging Company, 260 Maple street, Lynn, Mass. This consists of a very substantial handle and three blades of different lengths and widths. These are forged from square stock so that a wrench can be used if necessary. The sizes shown are 6-, 7- and 8-inch blades.

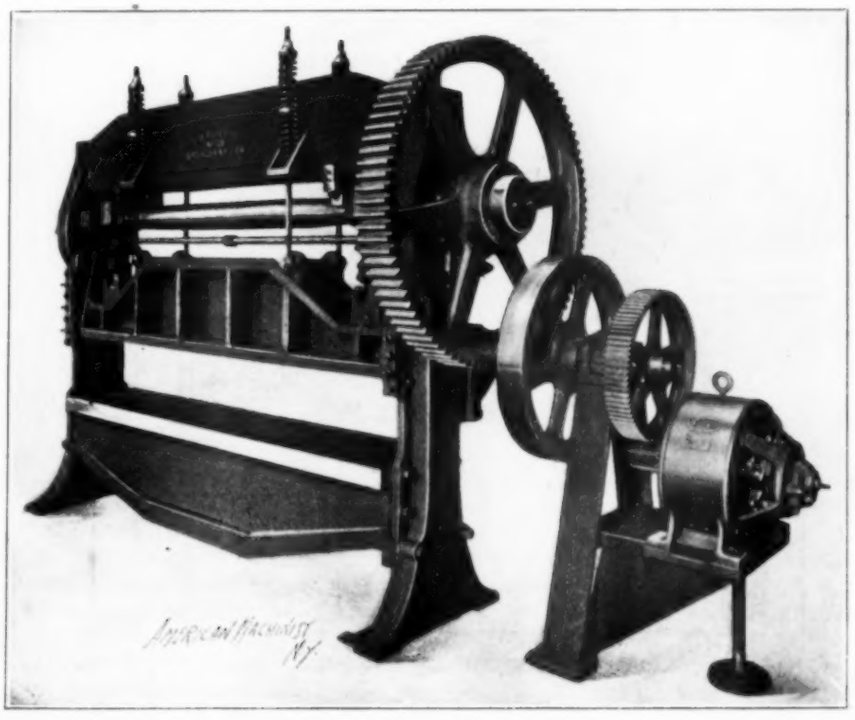


A SUBSTANTIAL SCREWDRIVER SET

## Special Double Crank Press

This shows a special double-crank press recently designed and built by the E. W. Bliss Company, Brooklyn, N. Y. It has a particularly heavy bed, slide and crown piece and other parts in proportion. This is for accurate cutting and punching operations extending over the entire breadth of wide sheets to be fed through the machine from front to back, or similar operations extending over the entire length of plates to be laid on the dies. The machine is so arranged that an automatic feed for sheets from 6 to 10 feet wide and up to 40 inches long may be readily attached, the feed varying from 0 to 6 inches. It may also be fitted with knock-out for lifting work from the dies if required.

The safe working capacity of the machine is from 100 tons for operations re-



A SPECIAL DOUPLE CRANK PRESS

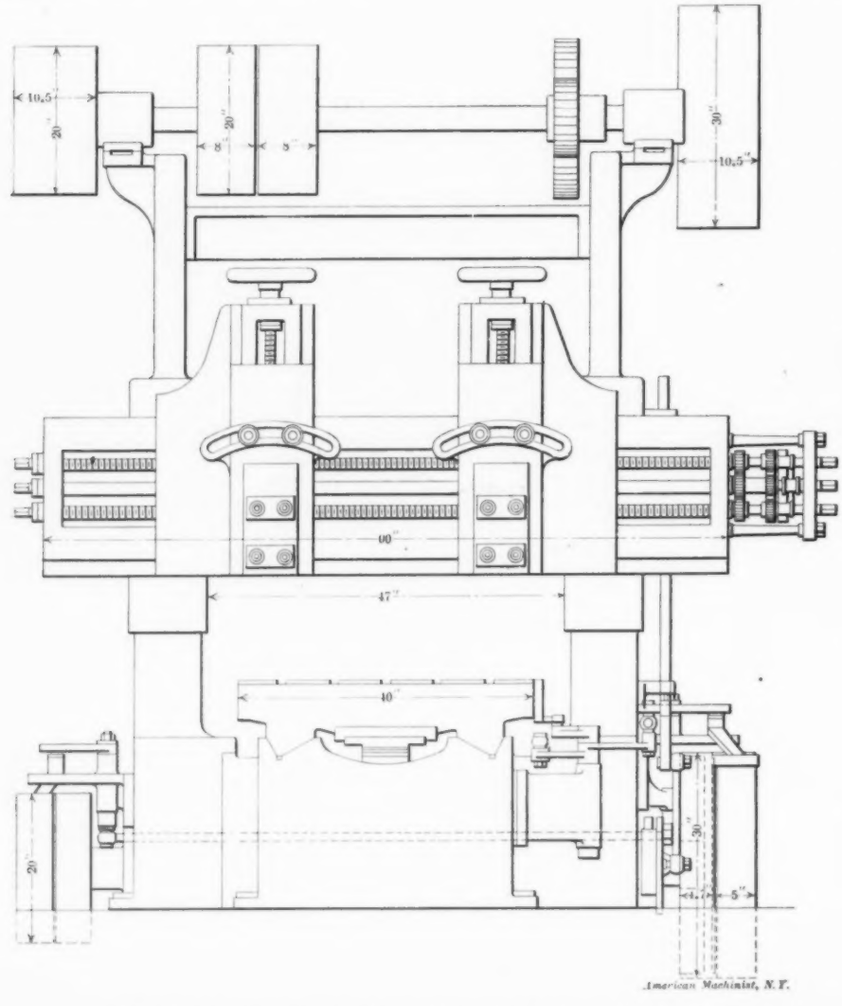
quiring great rigidity such as those first mentioned, up to 140 tons.

Both crank connections are adjustable simultaneously by the rotation of a shaft connecting by gears to the adjusting screws of liberal diameter. An inside bearing is provided adjacent to each crank to receive upthrust. The frame of the machine is sectional, the bed, crown and end columns being independent castings bolted together and so grooved as to relieve the bolts of all stress due to pressures transmitted. All the gearing has machine-cut teeth. The machine is driven by a direct-connected 10-horsepower, 220-volt Westinghouse motor making 650 revolutions per minute. The flywheel is 42 inches in diameter by 6 inches face, and weighs 900 pounds. The press is geared 36.1 and makes 18 strokes per minute.

## A French Planer with Ways of Peculiar Angles

The accompanying illustration shows some of the leading details of a planer built by Lomont & Hurtu, of Albert, Somme, France. The dimensions given are the nearest approximation to English inches and show it to be practically a 47-inch planer by our method of designation. As will be seen, the forward and backing belts are on opposite sides of the planer, the tight and loose pulleys being shown at the top.

The peculiar feature of the machine is the angles used for the ways in the bed and on the table. While the total angle is 90 degrees as usual, it is divided so as to have the outside angle 30 degrees, and the inside angle 60 degrees from the vertical. This gives a flatter angle, or more nearly a flat surface for the inside bearing, and a steeper angle at the outside, which should prevent the tendency to ride under a heavy side cut, more effectively than the 45 degrees generally used. It would be interesting to know how the wearing qualities of these ways compare with those planed in the usual way, as it often happens that changes which may appear to have advantages are not borne out in practice.




A FRENCH PLANER WITH WAYS PLANED AT 60 AND 30 DEGREES

## Pratt and Whitney "Highpower" Twisted Drill

The Pratt & Whitney Company, Hartford, Conn., is just putting on the market a high-speed steel twisted drill known as the "Highpower" drill. In design it is essentially the same as a drill shown on page 490, Part 2, Volume 31, of 1908, except that another convolution has been added to the shank to increase the holding power in the socket. It is a taper-shanked, twisted flat drill, with both shank and barrel ground to size; the shank having a much shorter pitch to the twist than the barrel.

PRATT & WHITNEY NEW "HIGHPOWER" DRILL

Three drilling tests are reported as follows: Test No. 1, drill diameter 1¼ inches; material drilled, machinery steel 3½ inches thick; cutting-speed per minute, 98 feet; feed per revolution, 0.0145 inch; inches drilled per minute, 4.2; number of holes drilled, 100. At this point the drill was removed and found in practically as good condition as when the cutting was started.

Test No. 2, drill, 1¼-inch; material drilled, cast iron 3 inches thick; cutting speed per minute, 127 feet; feed per revolution, 0.0426 inch; inches drilled per minute, 14.9; number of holes drilled, 211. The drill was removed and was found to be practically as good as when the test began.

In a third test a 1-inch drill was used in cast iron at a cutting speed of 156 feet per minute, a feed of 0.087 inch; drilling 51.9 inches per minute. This shows the holding power of the tapered shank and strength of the drill.

## Large Angle Bender

The bending of iron or steel bars of various shapes often becomes quite a proposition unless a shop is equipped for it. Estep and Dolan, Sandwich, Ill., have brought out a new angle bender on the same lines as their smaller machine, known as No. 3. This has a capacity of bending round or square stock cold, up to 1¼ inches, to a right angle, and it can also be used for flat stock up to ½x4 inches, such as hangers used in building construction.

# Something New in Hydraulic Machines

The use of steel for frames, cylinders and beam in their beam shearing and coping machine is the latest development of the Watson-Stillman Company, of New York.

### Beam Shear

Is made in two sizes, 15 and 24 inches, respectively, and operates at a pressure of 1500 pounds per square inch in operating cylinder, but is so designed that by change of cylinders they have a range of from 1000 to 3000 pounds.

In shops where the line pressure is lower than these figures, the machines may be operated through an intensifier. Where the work to be sheared varies much in sectional area there is an advantage in using a variable pressure intensifier, as it permits operating at low pressures, and, consequently, a saving of power when the work is small.

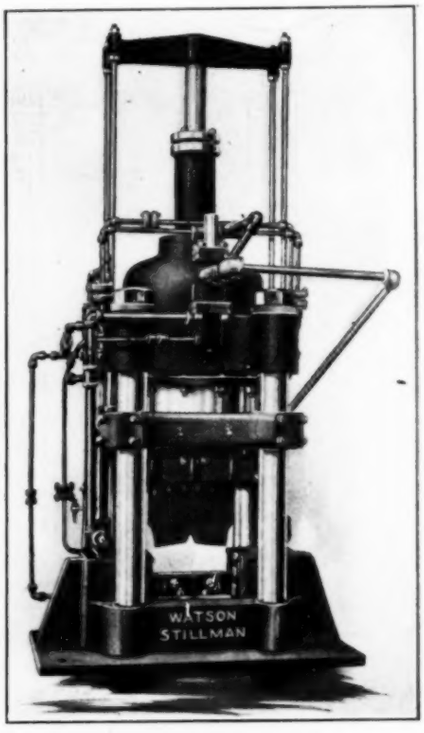



FIG. 1. BEAM SHEAR

### Shearing Knives

Aside from the steel construction perhaps the most unique feature of the machine is the design of the upper cutting knives, which have decided advantages over the solid knives ordinarily used, in that they are divided and fastened to hinged holders, which allow an added horizontal movement to the knives and do away with the tendency to distort the work.

This design of knife effects a saving in blades, which are cheaper and have an added advantage of being more readily reground and, when worn below the working limit, can be cut down for use on smaller sections, the whole making for cheaper maintenance.

As shown in Fig. 2, the beam is supported from underneath and at the sides by double stationary knives which conform to its shape and form a slot into which the upper knives descend.

The lower knives are supported by the platen or bolster, while those on the sides of the beam are wedged into position, and, consequently, have the machine frame as a solid backing.

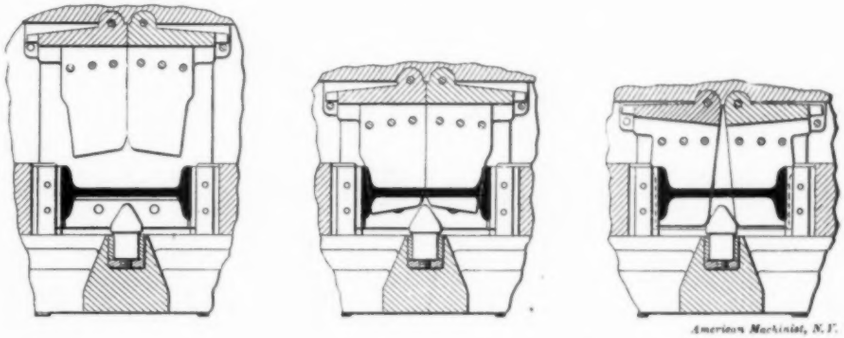



FIG. 2. SECTIONAL VIEW OF KNIVES

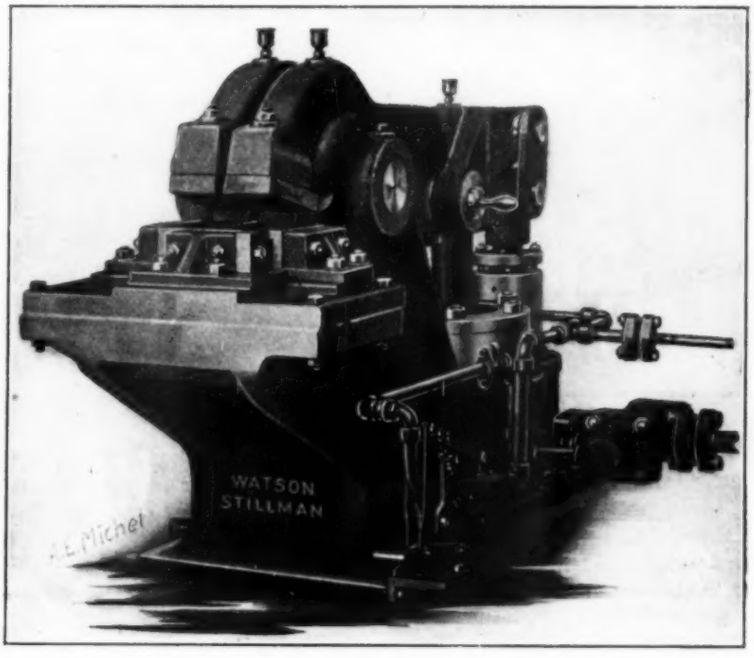



FIG. 4. COPING MACHINE

### Shearing the Beam

When the machine starts to perform its function, the upper knives first pass through the web of the beam, as shown in View 2, Fig. 2, into the slot between the lower knives. As the stroke continues carrying the knives still lower, they come in contact with the dividing post, which forces them outward as they pass in shearing action through the flanges. The cut being continuous it gives a clean shear.

### Operation of Machine

Fig. 3 is a sectional view of the machine and gives a clearer view of its operation. The beam is placed in position for the cut and is clamped in position by admitting hydraulic pressure into the auxiliary cylinders forcing the piston down, operating the rods which control the clamping wedge on which the outer shears are mounted, thus gripping and holding the beam rigidly in position.

With the foot lever, hydraulic pressure is admitted into the main cylinder, driving the ram which holds the shearing knives downward, forcing the knives through the web of the beam, and as the stroke continues the knives are parted by the dividing post or wedge, and, swinging about the centers *O O*, pass through the

flanges of the beam, as shown in View 3, Fig. 2. The pressure is exhausted from the main cylinder by release of the foot pressure on lever, and the ram is raised by the pressure in the pull-back cylinder and the knives are again in position for the next cut.

The clamping device or pressure against the beam is released by the hand lever, which admits pressure below the pistons of the auxiliary cylinder and thus raises the wedges.

The machine has a wide range of usefulness as the design allows rapid changing of the knives to cut channels, flat bars,

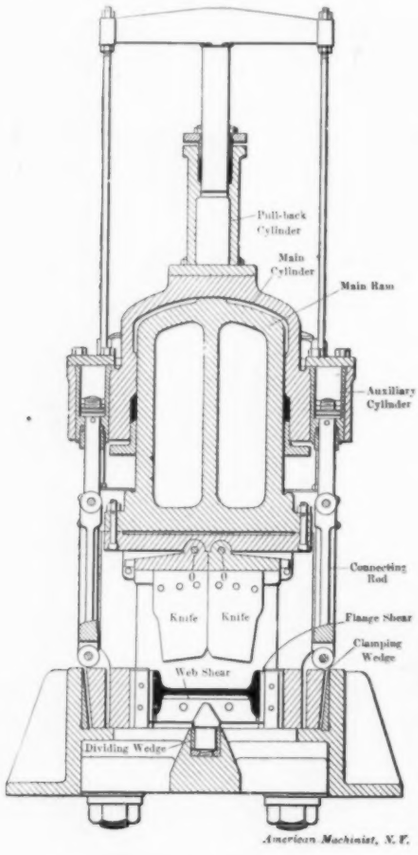



FIG. 3. SECTION OF BEAM SHEAR

angle bars, Z-bars, and various other structural shapes, and by removal of the cutting mechanism it may be converted into a powerful hydraulic press.

### Hydraulic Coping Machine

This machine, which has the same steel construction, consists of a heavy steel beam, as shown in Fig. 4.

This beam is operated by hydraulic pressure at the rear to concentrate greatest power upon the shearing knives in front. The forward end of this beam or lever is divided and so constructed that by the removal of the pin, as shown at the right of the machine in Fig. 4, the half containing the upper right-hand knife may be thrown out of action and the knife left standing at its upper limit.

This divided construction permits the insertion of a flange or web when it is desired to shear close to these parts. The lower or stationary knives are bolted to the plates in such manner that those on any side may be readily removed without disturbing the others.

### Operation of Machine

Through the medium of the foot lever, as shown in Fig. 4, working pressure is admitted into the main cylinder. This pushes the ram upward and transmits its power through a ball-ended connecting rod, as shown in sectional Fig. 5, to the

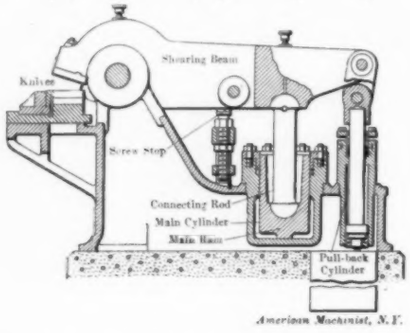



FIG. 5. SECTIONAL VIEW OF HYDRAULIC COPING MACHINE

beam, and moves the knives to their lowest limit.

The liquid is exhausted from the main

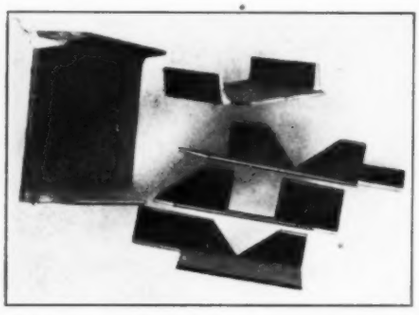


FIG. 6. A FEW OF THE MANY COMBINATIONS OF CUTS

cylinder by releasing the foot lever, and the pressure is thrown onto the top of the piston in the pull-back cylinder, and brings the shearing beam back to initial position. The length of lever stroke is adjustable through the medium of a screw stop between the main bearing and the cylinder, as shown in Fig. 5.

### General Construction of the Coping Machine

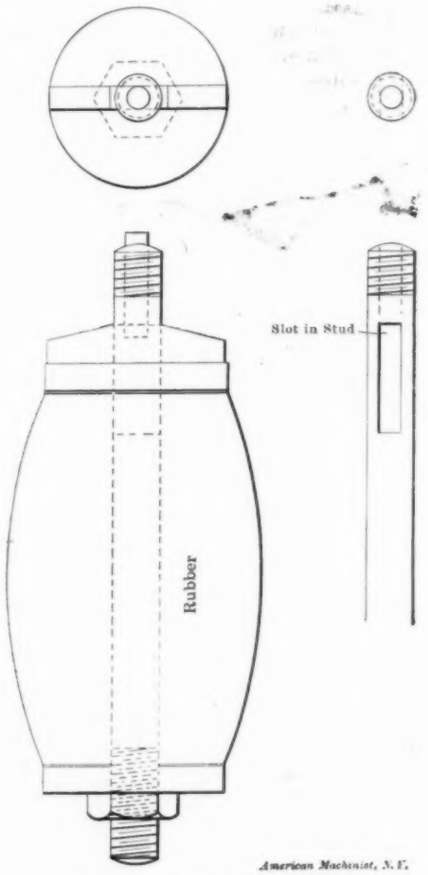
The body of the machine is heavily ribbed along the lines of greatest stress. Its general construction offers a large number of cutting combinations, some of which are shown in Fig. 6, and it is capable of very rapid change from one combination to another.

This machine is built to operate under the same working pressure as the beam shear, 1500 pounds per square inch, with a range between 1000 and 3000 pounds as desired.

## A Spring Pressure and Knockout Device

By C. H. Brenton

The cut herewith shows clearly a device used on many forming and bending




A SPRING PRESSURE AND KNOCKOUT DEVICE

dies where a pressure pad or knockout is used, having a single pin placed in the center.

Many dies are made having a contrivance of some sort to perform this work, made permanent with the die, which makes the die clumsy and awkward to handle, while this arrangement is efficient and does not interfere with easy handling of the die.

This device can be made in several different sizes, to suit the work, and as they are self-contained, can be screwed into place in the die-shoe, when the die is set up in the press.

The sketch shows rubber used as a cushion, but a spring can be used instead if desired.

# The United States Signal Corps Aeroplane

## The Wright Machine That Met the Specifications by Carrying Two Men for an Hour's Flight and Making a Speed of 42 1-2 Miles per Hour

SPECIAL CORRESPONDENCE

In Volume 31, Part 2, beginning at page 473, the AMERICAN MACHINIST presented a number of illustrations of the Wright aëroplane, shortly before that time on trial before an official board of the Signal Corps of the United States Army at Fort Meyer, Va., and described in detail its construction and operation. The unfortunate accidental wrecking of this machine, with the lamentable death of Lieutenant Selfridge of the United States Army, is now one of the best known events in the history of American aëronautics.

During June of this year the Wright Brothers delivered another aëroplane at Fort Meyer and prepared for the necessary trials to meet the army specifications. This machine differs in some details from the machine of 1908, and these differences of construction, together with a review of the successful trial flights, will be treated of in this article.

### THE ILLUSTRATIONS

Turning to the half-tones, Fig. 1 shows the machine of 1909 in flight during one of the preliminary trials and at a point near the starting tower, which can be seen at the left of the illustration. Figs. 2 and 3 show a three-quarters front and rear view, respectively. Here the machine is seen in position upon the starting track, just prior to a flight. As will be noted, the general features of the design are the same as those of the machine of 1908. The other illustrations, Figs. 4 to 7 inclusive, are of details comparing the construction of 1908 with that of the machine which has but recently fulfilled the Government provisions.

### THE ARMY SPECIFICATIONS

As the army specifications have been met by this machine, it is in order to restate briefly the principal requirements. These are, that the machine must be designed to carry two persons, having a combined weight of about 350 pounds, and sufficient fuel for a flight of 125 miles. The machine must be designed for a speed of at least 40 miles per hour in still air and payment will be based upon this speed; that is, a 10 per cent. reduction from the contract price will be made for every mile that the machine falls short of 40 miles per hour, with a further provision that if the machine fails to make a record speed of at least 36 miles per hour, it will be rejected. Similarly, a bonus of 10 per cent. of the contract price will be paid for every mile per hour greater than 40 miles per hour. Before acceptance, a trial endurance flight must be made of at least one hour, during which time the flying machine must remain continuously in the air without landing.

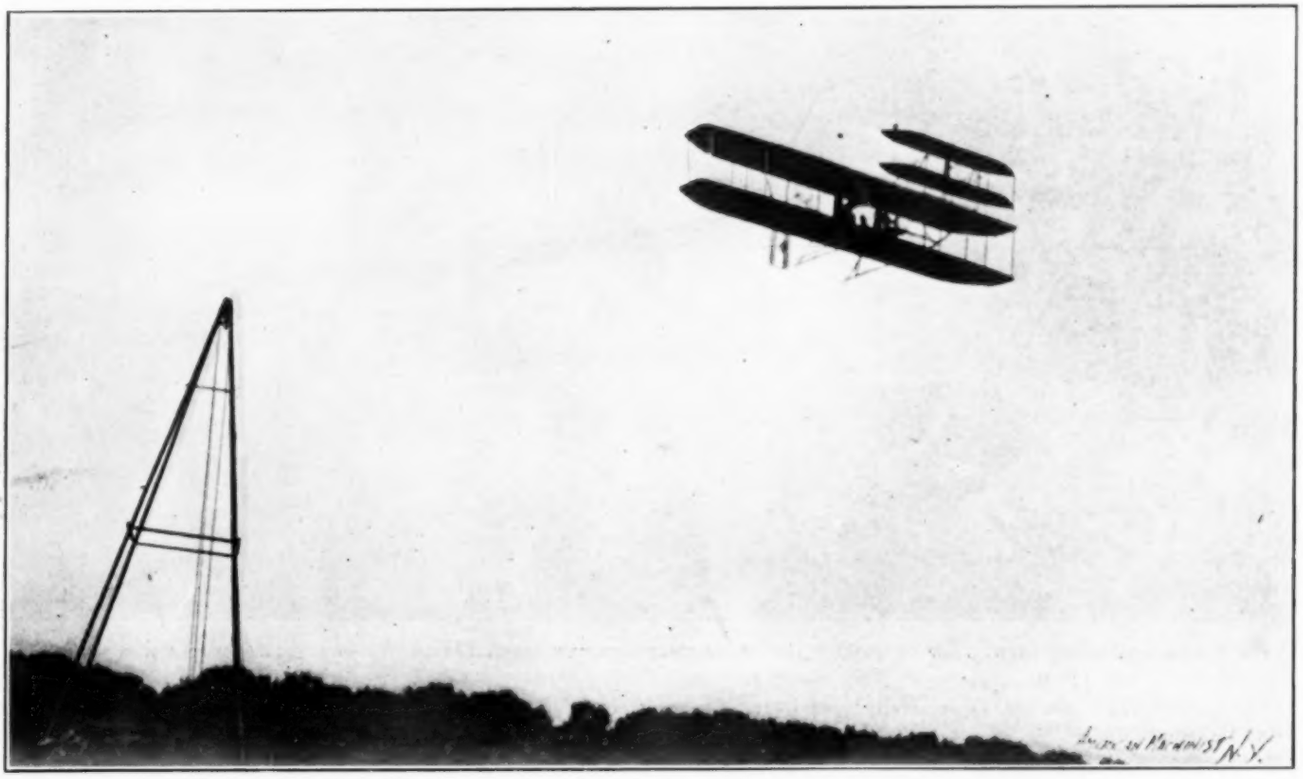


FIG. 1. WRIGHT AËROPLANE IN FLIGHT AT FORT MYER, JULY, 1909

### DIFFERENCES BETWEEN THE AËROPLANE OF 1908 AND THE AËROPLANE OF 1909

The principal difference between these two machines is the lessened length and area of the main surfaces of this year's machine. The machine of 1908 was 41 feet long; the machine of 1909 is 36 feet 4 inches long. The total reduction of main plane surface is about 80 square feet.

The vertical distance between the planes has been decreased from 6 feet 10 inches, which prevailed in the machine of 1908, to 4 feet and 6 inches. The hight of the skids has been slightly increased, thus bringing the lower main plane a slightly greater distance away from the ground when the machine is at rest.

A change in detail of construction is shown in Figs. 4 and 5, illustrating the staying of the rear rudder. Fig. 5 shows

a more elaborate system of guying and trussing than Fig. 4. This change was brought about by the accident of last year in which the tearing loose of a guy wire contributed largely to the cause of the disaster. This change was thus made as a precautionary measure. Another change in detail is illustrated by Figs. 6 and 7. Fig. 6 shows the former, single, semi-circular steadying vane between the main planes of the front control, and Fig. 7 shows two of these semi-circular vanes as they are in the machine of 1909. Two were found necessary to keep the machine from drifting sidewise while going at the increased speed.

The power plant of this year's machine is the same as the one of last year. The engine was not injured in the wreck; was sent to Dayton; revamped and is now in

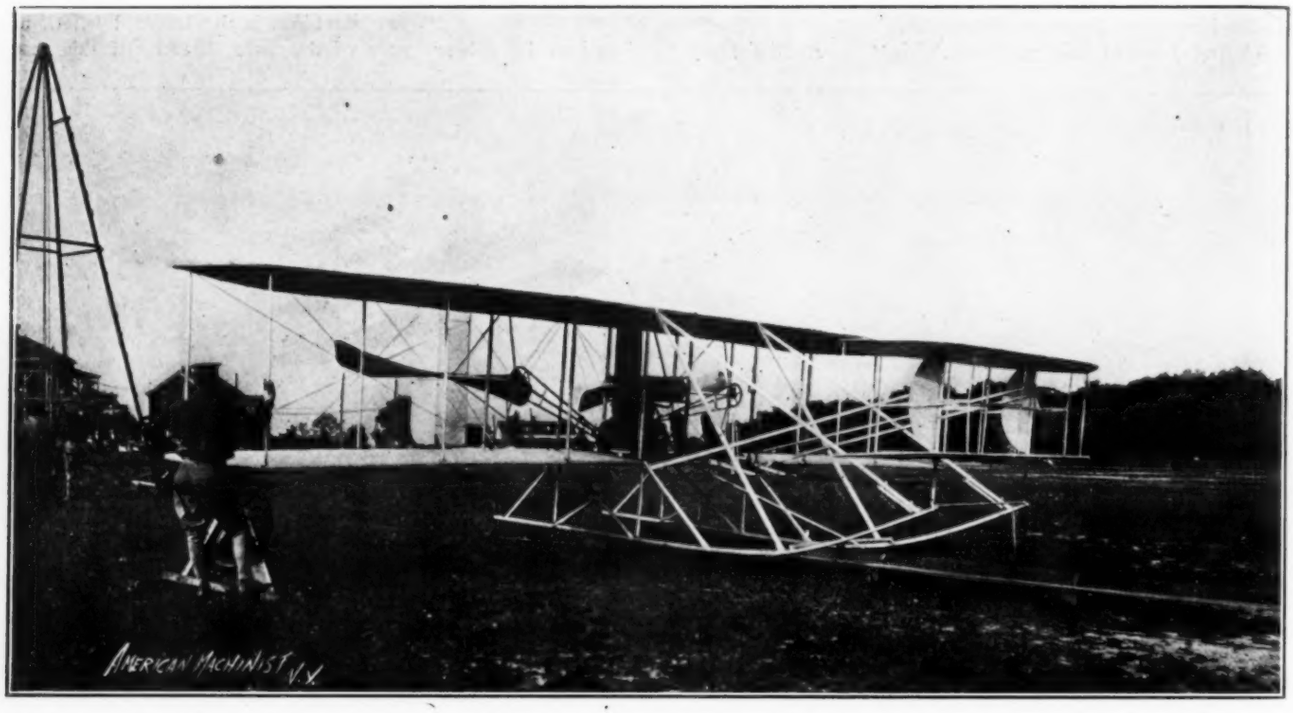



FIG. 2. THREE-QUARTERS FRONT VIEW OF WRIGHT AËROPLANE THAT MET THE SPECIFICATIONS OF THE UNITED STATES WAR DEPARTMENT

the machine which has just successfully met the trials.

### Orville Wright's Flights at Fort Meyer, Va., September, 1908

In view of the importance of the successful achievement of Mr. Wright, it is in order to review briefly the flights made with the first machine preliminary to describing the successful flights of a few days ago. The records here presented are taken from the official reports of the United States Army Signal Corps.

On September 1, 1908, after preliminary tests of the engine, the aëroplane was removed from the balloon house to the balloon tent on the drill grounds at Fort Meyer. The first flight was made on September 3. The velocity of the wind was 3 miles per hour. The maximum hight reached by the aëroplane was 35 feet. The aëroplane went around the field 1½ times and landed in front of the shed. The right-hand skid was broken in two places due to rough handling. This skid was repaired the next day and a flight of about 3 miles was made in a wind of 3 miles per hour. The time of this flight was 4 minutes and 15 seconds. The maximum hight was 40 feet.

On September 7, a flight of 55 seconds was made in a wind of 6 miles per hour with a maximum hight of 25 feet; the distance covered was estimated at ⅞ of a mile.

On September 8, two flights were made, one at 9:15 a.m., which lasted 11 minutes and 10 seconds in which the machine circled the field 13 times. The wind was blowing at the rate of about 2 miles per hour. On the second flight, the field was circled 8 times; the machine was in the air 7 minutes and 34 seconds and came down on account of darkness.

On September 9, Mr. Wright made a flight of 57 minutes and 25 seconds, going 57 times around the field and maintaining a hight of over 100 feet. This flight was made in the morning, beginning at about 8 a.m. In the afternoon in a wind of 4 miles an hour, the field was circled 65 times at a maximum hight of 80 feet. The machine remained in the air 1 hour, 2 minutes and 15 seconds. The third record flight was made immediately thereafter when Mr. Wright circled the field 6½ times at a maximum hight of 60 feet; he was in the air 6 minutes and 24 seconds and carried Lieutenant Lahm as a passenger.

On September 10, in a wind of 10 miles an hour, the field was circled 8 times at a maximum hight of 200 feet. The machine remained in the air 1 hour, 5 minutes and 52 seconds.

On September 11, two flights were made. During the first the machine circled the field 9 times and was in the air 10 minutes and 50 seconds. On the second the field was circled 57½ times; elapsed time, 1 hour, 10 minutes and 24 seconds. During this flight, the machine described two figure-eights over the drill grounds.

On September 12, two flights were made. On the first, Major George O. Squier, of the Signal Corps, was a passenger and a record flight of 9 minutes and 6 seconds resulted for a two-man flight. During the second flight, Mr. Wright was alone. This flight lasted 1 hour and 15 minutes, during which time the field was circled 71 times and a maximum hight of 300 feet was attained. September 17 was the date of the unfortunate and lamentable accident. At 5:14 p.m. Orville Wright ascended with Lieutenant Selfridge as a passenger in a wind blowing at the rate of 4 miles per hour. After circling the field 4½ times, a propeller blade was seen to fall. The machine at that time was at a hight of about 150 feet. Mr. Wright shut off the power and guided the machine down to an elevation of about 75 feet during an advance of about 200 feet. At this point the machine turned downward and dropped the remaining distance, 75 feet, to the ground.

The official report of the aëronautical board of the Signal Corps reads as follows: "That the accident which occurred in an unofficial flight made at Fort Meyer,

Va., at about 5:18 p.m., on September 17, 1908, was due to the accidental breaking of a propeller blade and a consequent unavoidable loss of control which resulted in the machine falling to the ground from a hight of about 75 feet.

"The board finds that First Lieutenant Thomas E. Selfridge, 1st Field Artillery, attached to Signal Corps by War Department orders and assigned to aëronautical duty, accompanied Mr. Wright by authority on the aëroplane for the purpose of officially receiving instructions, and received injuries by the fall of the machine which resulted in his death."

### Orville Wright's Flights at Fort Meyer, June and July, 1909

On June 29, 1909, the aëroplane which later successfully met the requirements of the specifications of the War Department was taken from its shed for the first of the preliminary trials. Four short flights were made. On the day following and on July 1 trouble with the motor prevented flights of any great distance. On July 2, a flight of 11 minutes and 44 seconds was made, being the first flight for any distance in this series. This flight was terminated by the stopping of the motor while the machine was in the air at a hight of about 60 feet. In gliding to the earth, one end of the lower main plane struck the top of a small tree, causing the machine to pivot, swerve and strike the ground with considerable force. The skids were completely broken and the plane which struck the tree was badly ripped.

The first flight following the accident to the Wright aëroplane on July 2 occurred on July 13, wind and rain having prevented an ascension of the easily repaired machine before that date. The manner in which the two broken skids and a torn plane were repaired in four hours' time was an object lesson in the ease with which a Wright flying machine can be put in shape after an accident. Being built largely of wood, it lends itself readily to repairs in the field, a very great advantage in a machine to be used for military purposes.

On June 13, there were two attempts to fly, the machine going in each but the length of the field. The last of the two flights resulted in a broken skid, due to a sidewise turn, and, as was learned afterward, from the new skids replaced after the accident of July 2, being of too well seasoned wood. This broken skid was replaced the next day but broke in handling the machine, from being too dry to stand the strain of curving.

On July 17, after one false start, the aëroplane circled the Fort Meyer field for 16 minutes and 53 seconds. The time was short, inasmuch as the bearings remained stiff and short flights were desired by the Wrights to prevent overheating.

July 19 saw two beautiful flights, one of 25 minutes and 18 seconds, the other of 30 minutes flat; the following day, July 20, the bearings having run themselves into perfect condition, the American record for time in the air was broken and a new mark set at 1 hour, 20 minutes, 45 seconds. During this flight, a hight of nearly 300 feet was attained, which stands as an unofficial record for this country—unofficial because the machine did not pass over any balloon of known hight to mark the exact altitude.

July 21 was marked by one flight of more than ordinary significance, although of but 3 minutes' duration. After a few circuits of the parade ground, a magneto gear became loose and jarred off the machine, stopping the motor. The aëroplane was 60 feet in the air at the time, but glided to earth with perfect safety in a series of little dives downward which looked very much as if the machine were coming down a flight of invisible steps. The damage was soon repaired and another flight of 11 minutes was made. Previous to these flights, a lower gear was put on the machine, the ratio between engine shaft and propeller shaft being changed from 10 to 38, to 9 to 38. At the same time, the revolutions per minute of the engine were increased; the result was a gain of several miles an hour in speed. Wilbur Wright calculated from the time of passing two telegraph poles of known distance apart that the aëroplane was going 45 miles an hour.

July 26 saw a short flight in a wind of 18 miles an hour. President Taft was on the ground, and, not to disappoint him, Orville Wright departed from his usual cautious procedure and flew in a choppy breeze. The machine behaved well, although plunging about considerably. The event of the President seeing the premier American flying machine for the first time in the air was further marked by the aëroplane starting entirely under its own power, without the use of the starting weight. The stiff breeze blew directly up

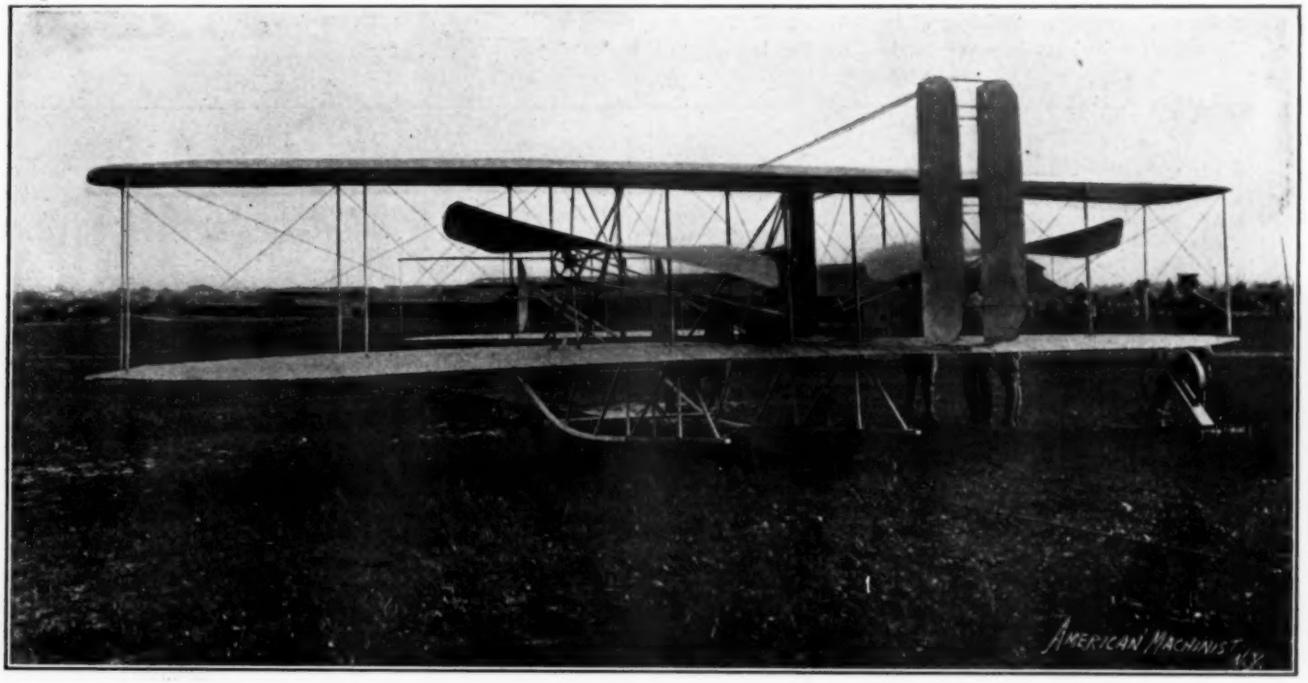



FIG. 3. THREE-QUARTERS REAR VIEW OF WRIGHT AËROPLANE THAT MET THE SPECIFICATIONS OF THE UNITED STATES WAR DEPARTMENT

the rail, and with only Wilbur Wright holding the end of the plane and running with the machine, the aëroplane darted down the track under its own power and lifted into the air with no apparent difficulty.

### The Official Endurance Flight

The endurance clause of the Wrights' contract with the Government was satisfied by the fine flight of July 27. The requirements were that the machine remain one hour in the air, carrying a passenger. The course taken and the speed made, were left to the discretion of the aviator and the capacity of the machine.

With Lieutenant Frank P. Lahm on board, Orville Wright cut loose from the restraining wires holding his machine to the end of the monorail at 6:36:40 p.m., July 27, and soared into the air with no difficulty. Many critics who had watched the earlier and somewhat inefficient flights of this machine, had made severe strictures on the policy of the Wrights in changing the dimensions of last year's successful flyer. This year's aëroplane, as stated elsewhere in this article, has some 80 square feet less supporting surface. It thus requires a greater speed to maintain itself in the air. For awhile it looked as if the new-dimensioned machine had not enough power to carry one man, let alone two, but time has proved the Wrights' knowledge of their device to be correct. In the hour endurance flight there was not the least difficulty in rising to a hight of 125 feet or of steering, maintenance of equilibrium, or forward and backward balance.

Not content with satisfying all the requirements of the aëronautical board, Orville Wright kept his machine going until he had beaten his brother Wilbur's record of 1 hour and 9 minutes, with a passenger, made at Le Mans, France, last year. Orville's total elapsed time was 1 hour, 12 minutes and 40 seconds, taken when a beautiful sliding landing had completed his record flight. Time was calculated from the instant the machine left the monorail to the time it touched the ground, and was an average of seven watches, six of them being held by the aëronautical board and one by a representative of the Aëro Club of America, acting as official timer for that organization.

There was nothing tentative about the demonstration of the reliability of the machine. During the hour Orville Wright covered at least 40 miles according to careful estimates. No absolute calculation was possible; first, because the numerous circuits of the parade ground were of widely differing lengths and, second, because no stakes had been placed by flying outside of which a minimum of his speed could be determined, as in Wilbur Wright's flight for the Mechlin trophy on the last day of 1908.

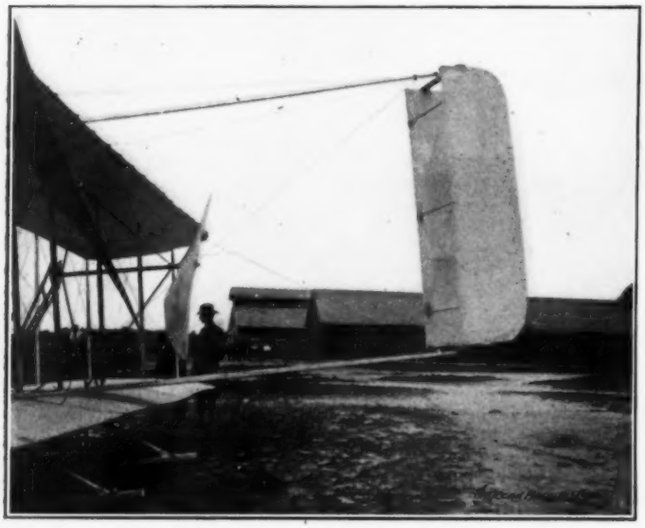


FIG. 4. RUDDER BRACES OF THE 1908 MACHINE

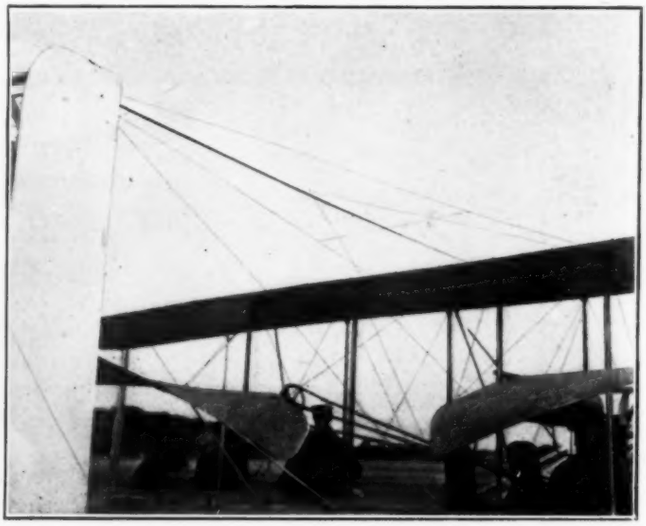


FIG. 5. RUDDER BRACES OF THE 1909 MACHINE

The machine was at all times under perfect control. The extra weight of the passenger seemed to have a steadying effect, the up-and-down motion of the aëroplane riding the invisible, but none the less present, air waves being much smoother and less jerky than on previous flights with lighter weight and greater speed. Lieutenant Lahm said after the flight that it was evident that the control was perfect. "No man could step into that aëroplane and run it without some practice, but it appears from close observation to be a matter of instinct and training only. Mr. Wright's hands moved the levers to steer and to correct irregularities of flight almost as they occurred. I am confident that it will not take long to teach a pupil how to operate the aëroplane."

### The Official Speed Flight

After exhaustive investigation of the surrounding country the Wrights picked the so called Alexandria course for their speed trial. The specifications called for a speed test from Fort Meyer field five miles out and return, but left the direction to the Wrights. Five miles from the field to Shooter's hill, outside the Virginia city, was the course, and there the turning point was marked by a small feeder or storage balloon inflated with hydrogen. A second balloon was flown at Four-mile run, some three miles from the starting point. The starting point from which time was taken was marked by two flags and a stake, all in line across the field, behind the last of which the three judges sat and took stop-watch time as the machine crossed and recrossed the line. Three judges at the other end of the course took time between the machine passing the balloon going down and repassing it going back. The time when the machine crossed the lower line was 'phoned in to the judges at the upper end of the course, which gave them, on their watches, the time for the first lap. The recrossing of the lower line was similarly 'phoned to the upper end, and this, together with the finish time, gave the time for the second lap.

It was essential to time the machine by laps, rather than by total elapsed time, less the turning point time, inasmuch as it was not the time required to cover 10 miles out and back which counted, but the rate per hour. Obviously, if a strong wind had been in the aviator's face, his time on one lap might have been very slow—his time on the other, very fast indeed, yet the total time and the total distance would yield a low speed rate.

The average time for the three watches at each end was taken as the mean time. No allowance was made for wind conditions, and for this reason the Wrights failed to fly on several days when they had planned to do so, preferring to wait for a wind in line with the flight, which

would not retard speed more on one lap than it would make up on the other. A cross wind, of course, would retard the speed both going and coming. "Good conditions may mean several thousand dollars in a bonus—bad ones several thousand dollars in fines," said Wilbur Wright before the attempt. "Naturally, we want to get the best conditions possible."

The Wrights asked for an extension of time from July 28 to, and including, July 31, which was readily granted. Every effort had been made to complete the contract on time but a series of accidents and bad weather had prevented its accomplishment.

The course from Fort Meyer to Shooter's hill over rough and broken country was patrolled by troopers from Fort Meyer, instructed to render any assistance possible in the event of a breakdown, and constant telephonic communication through specially laid Signal-Corps lines was kept up between the two ends and the middle of the course.

The speed test made on the 30th of July was a convincing demonstration of the value of the machine for military purposes. Orville Wright, with Lieutenant Benjamin D. Foulois as passenger, flew 10 miles over broken country—5 miles away from Fort Meyer and 5 miles back, making an average speed for the two laps of 42.583 miles per hour. No accident or incident of any kind marred this convincing demonstration of the machine's reliability and of the fact that two men, fully knowing what they were doing, were content to put their faith in the mechanism. A hundred places on the course would have been impossible as places for descent—and, had anything stopped the motor, the machine and perhaps the occupants would have been destroyed.

Few sights have ever held popular imagination more spell-bound than that of this slender contraption of cloth, wood and engine, human life laden, setting out for the first time in the history of mankind to conquer the open country. Town-to-town flights abroad have been made over country as smooth as a billiard table, and tilled so that a soft landing was always possible. Here massive hills and deep valleys, heavily wooded forest, streams, trolley lines, telegraph poles and houses dotted the course. So long as the aviator staid up none of these things mattered, although a downward current of air over the valleys impeded him and made him, as he said later, "climb like forty coming back." But for all that, the trip was a dangerous one, and is a record not only in the time and speed, but because it represents another barrier down between Nature and man's ceaseless effort for an entire conquering of her laws and forces.

The times for each lap, as obtained by the method described in an above paragraph, were, for the out-lap, at the rate of 37.735 miles per hour; for the in-lap, at the rate of 47.431 miles per hour, an average of 42.583 miles per hour for both. This speed earned the Wrights a bonus of $5000 over the price of $25,000 the Government had agreed to pay; each full additional mile over 40 netted $2500.

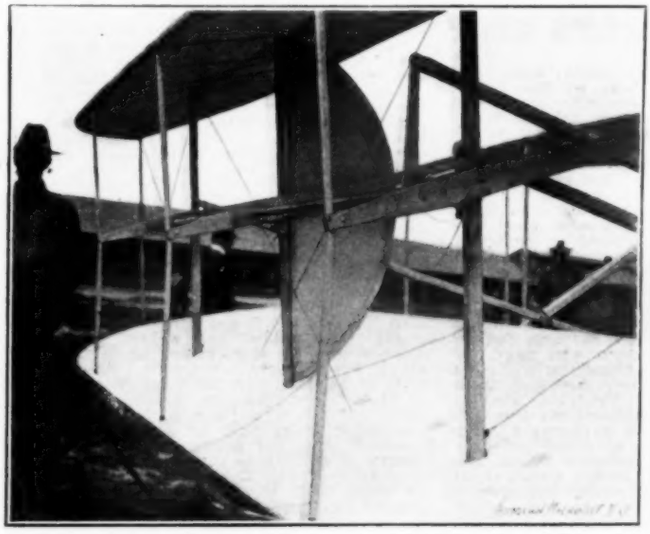


FIG. 6. SINGLE SEMI-CIRCULAR VANE OF THE 1908 MACHINE

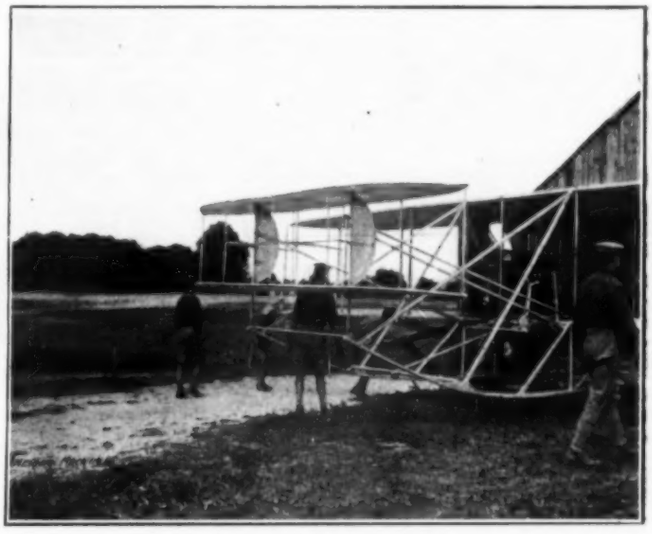


FIG. 7. TWO SEMI-CIRCULAR VANES IN THE 1909 MACHINE

---

According to the *Electric Journal*, the following method for drilling slate and marble has been found to give excellent results: Use ordinary twist drills for holes 1½ inches or less in diameter, giving the lip plenty of clearance; above this size, wing cutters will give better results. Keep tool thoroughly wet with water while cutting, and keep clean to avoid jamming. A speed of 400 revolutions per minute for ¾ inch or less and 200 revolutions per minute above ¾ inch will be found satisfactory. Feed by hand and be careful when nearly through, as the material is apt to break off in large pieces; for this reason a machine feed is not desirable.

## A Novel Scheme of Draftsman's Cells

By Ralph W. Davis

Every drafting room has some arrangement of tables or light that is different from all others, and the visitor will notice such features at once. Some time ago, while visiting a shop in the oil regions, not far from Mr. Osborne's locality, I noticed what was, to me, a novel scheme for a drafting room by which the men were isolated in almost absolute silence, yet there was plenty of light and every man was visible from the chief's desk.

A dozen draftsmen are employed and a series of glass cells had been built, each holding two men and their equipment. The walls extending from floor to ceiling were of large-size window glass in frame work with a suitable door to complete the construction. This allowed a good light to reach each man, and when sitting at a board with the door closed all the little distractions, such as typewriter clicking, talking, etc., were entirely absent. Of course, the men could see each other and indulge in pantomime or sign language if they so desired, but this would not disturb the entire force, as so often happens in the ordinary drafting office.

But it certainly looked odd, and the draftsmen, while admitting the advantage of quiet, uninterrupted work were *not unduly enthusiastic* in their comments. It would seem as if the addition of a telephone in each cell would about perfect the arrangement.

I have since wondered if there was enough additional work turned out to make up for the cost of this novel construction.

# Machinery and Metal Schedules of the New Tariff

The new tariff bill that the United States Congress has been considering for several months was signed by the President on August 5 and went into effect. From the metal schedule, schedule C, have been selected the sections dealing particularly with metals, materials used in machinery building, and machinery itself.

118. Iron in pigs, iron kentledge, spiegeleisen, and ferromanganese, two dollars and fifty cents per ton; wrought and cast scrap iron, and scrap steel, one dollar per ton, but nothing shall be deemed scrap iron or scrap steel except waste or refuse iron or steel fit only to be remanufactured by melting, and excluding pig iron in all forms.

119. Bar iron, muck bars, square iron, rolled or hammered, comprising flats not less than one inch wide nor less than three-eighths of one inch thick, round iron not less than seven-sixteenths of one inch in diameter, three-tenths of one per cent. per pound.

120. Round iron, in coils or rods, less than seven-sixteenths of one inch in diameter, and bars or shapes of rolled or hammered iron, not specially provided for in this section, six-tenths of one cent per pound: Provided, That all iron slabs, blooms, loops or other forms less finished than iron in bars, and more advanced than pig iron, except castings, shall be subject to duty of four-tenths of one cent per pound: Provided further, That all iron bars, blooms, billets, slabs or loops, in the manufacture of which charcoal is used as fuel, shall be subject to a duty of eight dollars per ton.

121. Beams, girders, joists, angles, channels, car-truck channels, TT, columns and posts or parts or sections of columns and posts, deck and bulb beams, and building forms, together with all other structural shapes of iron or steel, not assembled, or manufactured, or advanced beyond hammering, rolling, or casting, valued at nine-tenths of one cent per pound or less, three-tenths of one cent per pound; valued above nine-tenths of one cent. per pound, four-tenths of one cent per pound.

122. Boiler or other plate iron or steel, except crucible plate steel and saw plates hereinafter provided for in this section, not thinner than number ten wire gage, cut or sheared to shape or otherwise, or unsheared, and skelp iron or steel sheared or rolled in grooves, valued at eight-tenths of one cent per pound or less, three-tenths of one cent per pound; valued above eight-tenths of one cent and not above one cent per pound, four-tenths of one cent per pound; valued above one cent and not above two cents per pound, five-tenths of one cent per pound; valued above two cents and not above three cents per pound, six-tenths of one cent per pound; valued at over three cents per pound, twenty per centum ad valorem: Provided, That all sheets or plates of iron or steel thinner than number ten wire gage shall pay duty as iron or steel sheets.

123. Iron or steel anchors or parts thereof, one cent per pound; forgings of iron or steel, or of combined iron and steel, but not machined, tooled, or otherwise advanced in condition by any process or operation subsequent to the forging process, not specially provided for in this section, thirty per centum ad valorem; anti-friction balls, ball bearings, and roller bearings, of iron or steel or other metal, finished or unfinished, forty-five per centum ad valorem.

129. Sheets of iron or steel, polished, planished, or glanced, by whatever name designated, one and one-half cents per pound: Provided, That plates or sheets of iron or steel, by whatever name designated, other than the polished, planished, or glanced herein provided for, which have been pickled or cleaned by acid, or by any other material or process, or which are cold rolled, smoothed only, not polished, shall pay two-tenths of one cent per pound more duty than the corresponding gages of common or black sheet iron or steel.

130. Sheets or plates of iron or steel, or taggers iron or steel, coated with tin or lead, or with a mixture of which these metals, or either of them, is a component part, by the dipping or any other process, and commercially known as tin plates, terne plates, and taggers tin, one and two-tenths cents per pound.

131. Steel ingots, cogged ingots, blooms, and slabs, by whatever process made; die blocks or blanks; billets and bars and tapered or beveled bars; mill shafting; pressed, sheared, or stamped shapes, not advanced in value or condition by any process or operation subsequent to the process of stamping; hammer molds or swaged steel; gun-barrel molds not in bars; alloys used as substitutes for steel in the manufacture of tools; all descriptions and shapes of dry sand, loam, or iron molded steel castings; sheets and plates and steel not specially provided for in this section, all of the above valued at three-fourths of one cent per pound or less, seven-fortieths of one cent per pound; valued above three-fourths of one cent and not above one and three-tenths cents per pound, three-tenths of one cent per pound; valued above one and eight-tenths cents per pound, five-tenths of one cent per pound; valued above one and eight-tenths cents and not above two and two-tenths cents per pound, six-tenths of one cent per pound; valued above two and two-tenths cents and not above three cents per pound, eight-tenths of one cent per pound; valued above three cents per pound and not above four cents per pound, one and one-tenth cents per pound; valued above four cents and not above seven cents per pound, one and two-tenths cents per pound; valued above seven cents and not above ten cents per pound, one and nine-tenths cents per pound; valued above ten cents and not above thirteen cents per pound, two and three-tenths cents per pound; valued above thirteen cents and not above sixteen cents per pound, two and seven-tenths cents per pound; valued above sixteen cents and not above twenty-four cents per pound, four and six-tenths cents per pound; valued above twenty-four cents and not above thirty-two cents per pound, six cents per pound; valued above thirty-two cents and not above forty cents per pound, seven cents per pound; valued above forty cents per pound, twenty per centum ad valorem.

133. Grit, shot and sand made from iron or steel that can be used only as abrasives, one cent per pound.

134. Wire rods: Rivet, screw, fence, and other iron or steel wire rods, whether round, oval, flat or square, or in any other shape, and nail rods, all the foregoing in coils or otherwise, valued at four cents or less per pound, three-tenths of one cent per pound; valued over four cents per pound, six-tenths of one cent per pound: Provided, That all round iron or steel rods smaller than number six wire gage shall be classed and dutiable as wire: Provided further, That all iron or steel wire rods which have been tempered or treated in any manner or partly manufactured shall pay an additional duty of one-half of one cent per pound.

135. Round iron or steel wire, not smaller than number thirteen wire gage, one cent per pound; smaller than number thirteen and not smaller than number sixteen wire gage, one and one-fourth cents per pound; smaller than number sixteen wire gage, one and three-fourths cents per pound: Provided, That all the foregoing shall pay duty at not less than thirty-five per centum ad valorem; all wire composed of iron, steel, or other metal except gold or silver, covered with cotton, silk, or other material, corset clasps, corset steels, dress steels, and all flat wires, and steel in strips, not thicker than number fifteen wire gage and not exceeding five inches in width, whether in long or short lengths, in coils or otherwise, and whether rolled or drawn through dies or rolls, or otherwise produced, and all other wire not specially provided for in this section, shall pay a duty of not less than thirty-five per centum ad valorem; on iron or steel wire coated by dipping, galvanizing or similar process with zinc, tin, or other metal, there shall be paid two-tenths of one cent per pound in addition to the rate imposed on the wire of which it is made: Provided further, That articles manufactured wholly or in chief value of any wire or wires provided for in this paragraph shall pay the maximum rate of duty imposed in this section upon any wire used in the manufacture of such articles, and in addition thereto one cent per pound. And provided further, That no article made from or composed of wire shall pay a less rate of duty than forty per centum ad valorem; telegraph, telephone, and other wires and cables composed of metals and rubber, or of metal, rubber, and other materials, forty per centum ad valorem; barbed fence wire, three-quarters of one cent per pound, but the same shall not be subject to any additional or other rate of duty hereinbefore provided; wire heddles or healds, twenty-five cents per thousand and in addition thereto forty per centum ad valorem.

137. On all iron or steel bars or rods of whatever shape or section which are cold rolled, cold drawn, cold hammered, or polished in any way in addition to the ordinary process of hot rolling or hammering, there shall be paid one-eighth of one cent per pound in addition to the rates provided in this section on bars or rods of whatever section or shape which are hot rolled; and on all strips, plates or sheets of iron or steel of whatever shape, other than the polished, planished, or glanced sheet iron or sheet steel hereinbefore provided for, which are cold hammered, blued, brightened, tempered or polished by any process to such perfected surface finish or polish better than the grade of cold rolled, smoothed only, hereinbefore provided for, there shall be paid four-tenths of one cent per pound in addition to the rates provided in this section upon plates, strips or sheets of iron or steel of common or black finish of corresponding gage or value; and on steel circular saw plates there shall be paid one-fourth of one cent per pound in addition to the rates provided in this section for steel plates.

139. All metal produced from iron or its ores, which is cast and malleable, of whatever description or form, without regard to the percentage of carbon contained therein, whether produced by cementation, or converted, cast or made from iron or its ores, by the crucible, bessemer, Clapp-Griffith, pneumatic, Thomas-Gilchrist, basic, Siemens-Martin, or open-hearth process, or by the equivalent of either, or by a combination of two or more of the processes, or their equivalents, or by any fusion or other process which produces from iron or its ores a metal either granular or fibrous in structure, which is cast and malleable, excepting what is known as malleable-iron castings, shall be classed and denominated as steel.

141. Automobiles, bicycles and motorcycles, and finished parts of any of the foregoing, not including tires, forty-five per centum ad valorem.

142. Axles, or parts thereof, axle bars, axle blanks, or forgings for axles, whether of iron or steel, without reference to the stage or state of manufacture, not otherwise provided for in this section, valued at not more than six cents per pound, three-fourths of one cent per pound: Provided, That when iron or steel axles are imported fitted in wheels, or parts of wheels, of iron or steel, they shall be dutiable at the same rate as the wheels in which they are fitted.

144. Bolts, with or without threads or nuts, or bolt blanks and finished hinges or hinge blanks, whether of iron or steel, one and one-eighth cents per pound.

146. Cast-iron pipe of every description, one-fourth of one cent per pound.

150. Chain or chains of all kinds, made of iron or steel, not less than three-fourths of one inch in diameter, seven-eighths of one cent per pound; less than three-fourths of one inch and not less than three-eighths of one inch in diameter, one and one-eighth cents per pound; less than three-eighths of one inch in diameter and not less than five-sixteenths of one inch in diameter, one and six-eighths cents per pound; less than five-sixteenths of one inch in diameter, three cents per pound; but no chain or chains of any description shall pay a lower rate of duty than forty-five per centum ad valorem.

151. Lap welded, butt welded, seamed, or jointed iron or steel tubes, pipes, flues, or stays, not thinner than number sixteen wire gage, if not less than three-eighths of an inch in diameter, one cent per pound; if less than three eighths of an inch and not less than one-fourth of an inch in diameter, one and one-half cents per pound; if less than one-fourth of an inch in diameter, two cents per pound: Provided, That no tubes, pipes, flues or stays made of charcoal iron shall pay a less rate of duty than one and one-half cents per pound; cylindrical or tubular tanks or vessels, for holding gas, liquids or other material, whether full or empty, thirty per centum ad valorem; flexible metal tubing or hose, not specially provided for in this section, whether covered with wire or other material, or otherwise, including any appliances or attachments affixed thereto, thirty per centum ad valorem; welded cylindrical furnaces, tubes or flues made from plate metal and corrugated, ribbed or otherwise reinforced against collapsing pressure, two cents per pound; all other iron or steel tubes, finished, not specially provided for in this section, thirty per centum ad valorem.

155. Files, file blanks, rasps, and floats of all cuts and kinds, two and one-half inches in length and under, twenty-five cents per dozen; over two and one-half inches in length and not over four and one-half inches, forty-seven and one-half cents per dozen; over four and one-half inches in length and under seven inches, sixty-two and one-half cents per dozen; seven inches in length and over, seventy-seven and one-half cents per dozen.

159. Cut nails and cut spikes of iron or steel, four-tenths of one cent per pound.

161. Wire nails made of wrought iron or steel, not less than one inch in length and not lighter than number sixteen wire gage, four-tenths of one cent per pound; less than one inch in length and lighter than number sixteen wire gage, three-fourths of one cent per pound.

162. Spikes, nuts and washers, and horse, mule, or ox shoes, of wrought iron or steel, three-fourths of one cent per pound.

167. Rivets, studs, and steel points, lathed, machined, or brightened, and rivets or studs for nonskidding automobile tires, forty-five per centum ad valorem; rivets of iron or steel, not specially provided for in this section, one and one-fourth cents per pound.

168. Crosscut saws, five cents per linear foot; mill saws, eight cents per linear foot; pit and drag saws, six cents per linear foot; circular saws, twenty per centum ad va-

ad valorem; steel band saws, finished or further advanced than tempered and polished, five cents per pound and twenty per centum ad valorem; hand, back, and all other saws, not specially provided for in this section, twenty-five per centum ad valorem.

169. Screws, commonly called wood screws, made of iron or steel, more than two inches in length, three and one-half cents per pound; over one inch and not more than two inches in length, five cents per pound; over one-half inch and not more than one inch in length, eight cents per pound; one-half inch and less in length, ten cents per pound.

172. Aluminum, aluminum scrap, and alloys of any kind in which aluminum is the component material of chief value, in crude form, seven cents per pound; in plates, sheets, bars, and rods, eleven cents per pound; barium, calcium, magnesium, sodium, and potassium, and alloys of which said metals are the component material of chief value, three cents per pound and twenty-five per centum ad valorem.

176. Copper, in rolled plates, called braziers' copper, sheets, rods, pipes and copper bottoms, two and one-half cents per pound; sheathing or yellow metal, of which copper is the component material of chief value, and not composed wholly or in part of iron ungalvanized, two cents per pound.

182. Lead dross, lead bullion or base bullion, lead in pigs and bars, lead in any form not specially provided for in this section, old refuse lead run into blocks and bars, and old scrap lead fit only to be remanufactured; all the foregoing, two and one-eighth cents per pound; lead in sheets, pipe, shot, glaziers' lead and lead wire, two and three-eighths cents per pound.

185. Nickel, nickel oxide, alloy of any kind in which nickel is a component material of chief value, in pigs, ingots, bars, rods, plates, but not rolled or drawn, six cents per pound; sheets, strips and wire, thirty-five per centum ad valorem.

192. Watch movements, including time detectors, whether imported in cases or not, if having not more than seven jewels, seventy-five cents each; if having more than seven jewels and not more than eleven jewels, one dollar and thirty-five cents each; if having more than eleven jewels and not more than fifteen jewels, one dollar and eighty-five cents each; if having more than fifteen and not more than seventeen jewels, one dollar and twenty-five cents each and twenty-five per centum ad valorem; if having more than seventeen jewels, three dollars each and twenty-five per centum ad valorem; watch cases and parts of watches, chronometers, box or ship, and parts thereof, forty per centum ad valorem; lever clock movements having jewels in the escapement, and clocks containing such movements, one dollar each and forty per centum ad valorem; all other clocks and parts thereof, not otherwise provided for in this section, whether separately packed or otherwise, not composed wholly or in chief value of china, porcelain, parian, bisque, or earthenware, forty per centum ad valorem; all jewels for use in the manufacture of watches or clocks, ten per centum ad valorem; enameled dials for watches or other instruments, three cents per dial and forty per centum ad valorem: Provided, That all watch and clock dials, whether attached to movements or not, shall have indelibly painted or printed thereon the country of origin and that all watch movements, lever clock movements with jewels in the escapement, and cases of foreign manufacture shall have the name of the manufacturer and country of manufacture cut, engraved, or die-sunk conspicuously and indelibly on the plate of the movement and the inside of the case, respectively, and the movements shall also have marked thereon by one of the methods indicated the number of jewels and adjustments, said number to be expressed both in words and in Arabic numerals; and none of the aforesaid articles shall be delivered to the importer unless marked in exact conformity to this direction.

197. Cash registers, jute-manufacturing machinery, linotype and all type-setting machines, machine tools, printing presses, sewing machines, typewriters, and all steam engines, thirty per centum ad valorem; embroidery machines and lace-making machines, including machines for making lace curtains, nets, or nettings, forty-five per centum ad valorem: Provided, however, That all embroidery machines and Lever or Gothrough lace-making machines, and machines used only for the weaving of linen cloth from flax and flax fiber, and tar and oil spreading machines used in the construction and maintenance of roads and in improving them by the use of road preservatives, shall, if imported prior to January first, nineteen hundred and eleven, be admitted free of duty.

198. Nippers and pliers of all kinds, except blacksmith tongs, surgical and dental instruments or parts thereof, wholly or partly manufactured, eight cents per pound and forty per centum ad valorem.

# Trade Opportunities in Cuba and Panama

By M. de Moreira

Cuba, half American now, has benefited a good deal at the hands of American manufacturers in receiving uptodate machinery and having $141,000,000 of American capital invested in the country, which has brought the quick development of the island.

Naturally, the benefit has been reciprocal and has been the cause of a great loss to foreign countries, which previous to the time the United States took an interest in Cuba, had a very good export trade with her.

The exports from the United States to Cuba during the year 1908 amounted to $78,868,490, that of Spain for the same period being $958,207; the exports from Cuba to the United States were $41,576.98 whereas to Spain they amounted to $4,711,864.

## Railways

There are not many opportunities for railroad building in Cuba, although President Gomez has recently approved a new one. The Cuba Railroad Company will build a railroad from Marti, a station on the main line of that company, through Bayamo, Santa Rita, Jiguani, Baire and Palma Soriano and connect with the main line again at San Luis; also a branch from Bayamo through Veguita and Yara to Manzanillo.

The new extension will be about 175 miles long and is to be completed in May, 1911.

It is stated that the railroad company proposes to construct a large sugar mill, which will be ready as soon as the road is completed.

Up to June of the precedent year there existed 310 miles of railway in Cuba and 140 bridges, 57 of which are steel structures. Though the railway area is not very large, machine tools are very much needed as the repair shops are not equipped as they should be.

## Steamship Lines

Americans who have invested their money in Cuba realize that in order to succeed they should bring that island into as close and regular communication as possible with the United States. To bring this about, new steamship lines had to be formed and the old ones improved in their service.

The Tampa, Key West & Habana Steamship Company has inaugurated a new line of steamers between Tampa, Key West and Habana, making the trip in twenty-four hours, a saving of time over the previous service of ten hours. The company at present is giving semi-weekly service but is contemplating a daily one, in the near future. This company is organized under the laws of the State of New York and as they are to build eleven steamers, there is the certainty of work for American labor and manufacturers of machine tools for ship repair shops. Another company is to start a similar line, but they have not yet received their charter.

## Machinery

Machinery for ice making, sugar refining, cotton weaving, etc., will find a fair market in Cuba, but I must say that in spite of the good example shown by Americans, the Cubans are far less industrious than other Latin Americans. Many Latin American countries have been more or less unjustly called the lands of "mañana" but from my point of view that title belongs by right to Cuba, which as a matter of fact might be called the land of "passado mañana" (day after tomorrow).

## Panama

Panama, not speaking of the canal, offers some good opportunities in railway building and mining. A railway is to be built from the city of Panama to David. The plan of those who have submitted the proposition is to develop the port of Panama as a suitable terminal for the railroad when completed. The project comprises the building of a standard-gage railway and the reclamation of the lands to the south and west of the city which are left bare at low tide. The railroad station, yards, shops, deep-water docks for shipping of any draft, and dry dock for repairing vessels of any size and an adequate coaling station to meet the exigencies of the railroad and maritime requirements would be established on this land.

Undoubtedly the construction of this railway will greatly stimulate the growth and the prosperity of the city of Panama.

Another enterprise which ought to benefit American manufacturers is the establishment of an electric street car line, the work of which is to begin soon. Notwithstanding the manifest advantages and the richness and accessibility of the mining region in Panama, there has been but little development or exploitation of new properties.

The best mine is the Elremance which, though owned by English capital, is far from being worked on progressive lines, and American mining machinery is very much needed. One of the best opportunities which exist there now is the construction of the sugar refinery which is to be built in Panama.

The government has agreed to admit all materials, machinery, implements, etc., which may be necessary for the establishment of the refinery free of duty. On the other hand the concessionary has agreed to install an uptodate refinery, equipped with the latest machinery and appliances

and to construct wharves, etc., and to establish means of transportation such as railways, steamships, and to provide the rolling stock.

Surely American manufacturers have an excellent chance to sell their goods and a little effort, in this case, will bring them good returns.

## A Successful Marine Producer Gas Plant

A most interesting and instructive trial of a marine producer-gas plant has taken place on the motor boat "Marenging," built for H. L. Aldrich, of New York. The results are worthy of close study on the part of anyone interested in small marine power plants, and in the further extension of the field of the gas engine.

The following brief description of the plant and a trial run of 275 miles we take from *International Marine Engineering*:

This boat was brought out solely for the purpose of finding out whether a producer-gas plant could be used to advantage in marine work; whether within the limits of the space and weight available in an ordinary commercial marine power plant a gas producer could be built which would produce a clean, rich gas from the ordinary coal which is available in every market.

The boat is 40 feet long over all, with a beam of 9 feet, and a mean draft of 3 feet 6 inches, and is driven by a four-cylinder, four-cycle engine, with cylinders 5¼ inches in diameter by 6 inches stroke, which turns from 400 to 500 revolutions per minute. The engine is fitted with a reversing gear, mounted in an extension of the main bed, and drives a solid three-bladed bronze propeller 24 inches in diameter.

The engine used on this boat is a regular stock motor, designed for using gasolene (petrol), the only changes made for producer gas being in the nature of considerably higher compression than is ordinarily met in gasolene (petrol) engines. The inlet and exhaust valves and piping on this engine were exceptionally large, so that no changes were necessary on these parts. For the most successful operation on producer gas, the compression in the engine should be about 150 pounds per square inch. With this particular engine it was impossible to get much over 100 pounds, and, therefore, the results were not as good as could be expected with an engine especially designed for the service.

No attempt has been made to carry out tests involving extreme refinement because the inadequacy of the engine would make such tests of little value. What has been shown, however, is the fact that marine producer-gas plants can be successfully operated with remarkable economy. This has been well demonstrated to the satisfaction of the owner and many marine engineers and naval architects who have seen the plant in operation. Compared with a steam-power plant, this boat has shown remarkable economy, averaging a horsepower an hour on slightly over a pound of coal. In regular service the boat covers between 800 and 900 miles on a ton of anthracite pea coal, costing (depending upon where the coal is purchased) between $3.50 (14 shillings) and $5 (21 shillings). This amount of coal covers the banking of fires and starting up at frequent intervals. If the boat were started out on a continuous run, it is believed that it would make practically 1000 miles on a ton of coal. The average speed of the boat is between 8 and 9 miles an hour.

Such a nonstop run was attempted on July 9, the boat leaving the Hudson River Yacht Club, at the foot of West Ninety-second street, New York City, at 4:48 p.m., bound up the Hudson river to Albany and return, a distance of 275 miles. Unfortunately, considerable trouble was encountered in navigating the boat in certain parts of the river during the night, as large quantities of eel grass and weeds grow near the sides of the channel, in which the propeller became fouled a number of times, causing unavoidable shutdowns. Two such mishaps on the way to Albany delayed the boat for from 10 minutes to an hour each time, and the same difficulty was encountered, to a certain extent, on the return trip, preventing a strictly nonstop run. The results, however, even considering the shutting down and banking of fires, must be considered remarkable.

The summary of the trip is as follows:

July 9, 4:48 p.m., started from Hudson River Yacht Club dock; July 10, 3:30 p.m., arrived at first bridge at Albany; July 10, 3:32 p.m., started for New York; July 11, 10:15 a.m., arrived Hudson River Yacht Club dock; total mileage, 275; pounds coal burned to Albany, 351; pounds coal burned to New York, 285; total pounds coal burned for trip, 636; time to Albany, 22 hours 42 minutes; time to New York, 18 hours 43 minutes; time for entire trip, 41 hours 25 minutes; pounds of coal burned per mile to Albany, 2.55; pounds of coal burned per mile to New York, 2.07; pounds of coal burned per mile entire trip, 2.31; pounds of coal burned per hour to Albany, 15.45; pounds of coal burned per hour to New York, 15.20; pounds of coal burned per hour entire trip, 15.32.

One of the principal objects in view when this boat was brought out was to demonstrate to the owners of coastwise schooners in the lumber, coal, and other trades, also to the owners of fishing boats, oyster boats, and owners of yachts requiring less than 500 horsepower, the fact that producer gas has many striking advantages over either steam or gasolene (petrol). A producer-gas plant can be installed on a fore-and-aft-rigged vessel at small expense, and can be operated at very slight cost. The cost of operation with anthracite coal costing about $4 (16 shillings) per ton, as shown by tests made on the motor boat "Marenging," is practically one-tenth of what the cost would be if gasolene (petrol) were used at a cost of 15 cents (7½ pence) per gallon. As a matter of fact, gasolene (petrol) can seldom be bought at this price, and in many places it costs twice as much, so that the great economy of the producer-gas plant over a plant operated on gasolene (petrol) is evident.

As compared with a steam plant, the producer-gas plant, judging from the results obtained with "Marenging," can show a decided increase in economy over a steam plant, since a horsepower an hour can be obtained on slightly over one pound of coal; whereas in the ordinary tugboat using high-pressure steam it is doubtful if a horsepower an hour is obtained on much less than 5 pounds of coal. On large steamships and warships a steam-power plant shows, of course, better economy than a tugboat, a horsepower an hour being obtained on an average of from 1¾ to 2 pounds of coal. A saving of from 25 to 50 per cent. in such plants, however, means a large sum of money.

Another advantage which should recommend this type of installation as an auxiliary in coastwise schooners and the like, is the ease of operation. Any man who can take proper care of an internal-combustion engine can, without any difficulty whatever, manage a producer-gas plant. It requires little, if any, more skill to manage such a plant than it does to manage an ordinary kitchen range.

## Personals*

Frederic E. Town, who has been assistant to the general sales manager of the Otis Elevator Company, has recently been made manager of the Pittsburg office of his company.

Ralph B. Nickerson, formerly with the Chapman Valve Manufacturing Company, has entered the employ of the Blake & Knowles Steam Pump Company, East Cambridge, Mass.

Frank C. B. Page, first vice-president of the E. W. Bliss Company, returned on August 7 from a few weeks' trip abroad. Mr. Page's trip was a business one in order to advise with his company's London and Paris offices.

Otto J. Rantz, for four years in charge of shop-practice work at the Haverford College, Pennsylvania, was recently elected to the superintendency of the Stephens Industrial School, Lancaster, Penn., a free boarding school for the teaching of trades, the course including pattern making and machine design and construction.

*Items for this column are solicited.

## Forthcoming Meetings

International Association for Testing Materials, fifth congress, Copenhagen, Denmark, September 7-11.

International Association of Machinists, biennial convention in September, Denver, Colo.

Brotherhood of Railway Carmen, biennial convention in September, Atlanta, Ga.

National Machine Tool Builders' Association, fall meeting, October 12 and 13, New York City. P. E. Montanus, secretary, Springfield, Ohio.

## Business Items

The Automatic Machine Company, Bridgeport, Conn., builder of automatic screw-cutting lathes, presses and automatic wire-working machinery, owing to the rapid increase of its business, has had to find larger quarters. It has bought the plant of the Pacific Iron Works of the same city, on East Washington avenue, and will remodel to suit its requirements. This will enlarge its capacity and increase its facilities about four times, enabling it to take care of its growing business and make prompt deliveries.

# Want Advertisements

*Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.*

## Miscellaneous Wants

Caliper list free. E. G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—Manufacturers to build small air pumps in large quantities under contract. Box 486, AMERICAN MACHINIST.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Metal specialties manufactured; models, dies and special machinery. Inventions perfected; correspondence solicited. W. E. Villinger, Williamsport, Pa.

Manufacturers located in New York, or New England, equipped with facilities to build machinery weighing up to 5000 pounds, mostly lathe and planer work, may be interested by addressing Box 480, AM. MACH.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

A large well equipped machine shop on the south side of Chicago would like some work outside of its regular line; factory is equipped to do small and moderately heavy work; also experimental work; has good railroad facilities. Box 428, AMERICAN MACHINIST.

Mechanical engineer of experience in the operative end of manufacture expects to make two years' study of industrial conditions in France and Germany and will make special investigation on business and technical subjects. Box 477, AMERICAN MACHINIST.

A large manufacturing organization wishes to sell one of its departments which makes a sheet metal engineering specialty not now in their line. Splendid opportunity for man with moderate capital to start business for himself, or for a manufacturer to add a profitable line. Box 490, AMERICAN MACHINIST.

Active Partner Wanted—Owner of plant located in large city in the Middle West, manufacturing hoisting machinery, brick-making machinery, pumps and other special lines, desires to withdraw from active business. Will sell all or part of his holdings to right man on very liberal terms. Box 491, AMER. MACH.

## Situations Wanted

*Classification indicates present address of advertiser, nothing else.*

CONNECTICUT

Manager or salesman open for engagement; 15 years' experience in gas-engine business; reference, A-1. Box 507, AMER. MACHINIST.

Position as foreman of tool room or general machine department by a mechanic of 15 years' experience with ability to handle men and get results. Box 500, AMERICAN MACHINIST.

Norwegian (31), four years' shop experience, eight years office machinery trade, speaks German fluently, three years in this country, desires position, office or road; best references. "A. I. L.," AMER. MACHINIST.

ILLINOIS

Chief draftsman; engines, power plant, mining and general work; shop experience; expert designer; American. Address Box 475, AM. MA.

MASSACHUSETTS

Technical graduate desires to make change. Ten years' experience general mill work, construction work, machine design, shop supervision and charge of general engineering drafting room. References. Address Box 463, AM. MA.

NEW JERSEY

Draftsman, technical graduate, six years' experience on general machinery and automobiles, desires change. "R. M.," Box 510, AMERICAN MACHINIST.

Tool-room foreman desires change; large and varied experience; good technical education; have 50 men on finest of tools and dies. Box 511, AMERICAN MACHINIST.

Foreman and assistant superintendent is open for position; machinery, tool and die work, manufacturing, practical, executive; age 34; references; interview. Box 471, AM. MACH.

Position as foreman wanted; 12 years' experience as machinist, draftsman, foreman and factory manager; age 28; can produce the maximum at the minimum cost; manage male and female help to advantage; salary about $25. Address "J. G.," 936 Bloomfield St., Hoboken, N. J.

NEW YORK

Mechanical draftsman and engineer, eight years' experience, desires a change. Box 514, AMERICAN MACHINIST.

Practical mechanical designer with nine years' experience, automatic and general machinery, desires responsible position. Box 512, AMERICAN MACHINIST.

Designing engineer, high-grade automatic tools and machines; 17 years' experience, practical mechanic; graduate; can show records of successful accomplishments; any locality; $45 per week. Box 478, AMER. MACHINIST.

Mechanical engineer, 32, executive shop practice, designer, technical correspondent, electrical engineering, comprehensive and varied experience, aggressive, executive. Box 498, AMERICAN MACHINIST.

Mechanical draftsman with designing ability is open for responsible position; six years' experience. Employed, desires to change. Box 499, AMERICAN MACHINIST.

Production engineer will contract on a bonus or commission to raise your output and reduce your costs within specified time, and have it so production can be maintained. Have done it for others. Why not have your efficiency looked up? No systematizing scheme, but real expert service. Write for further particulars. T. A. Campbell, 500 5th Ave., New York City.

I wish to become connected with a manufacturing concern who is desirous of increasing the quantity and improving the quality of output with no increase in cost. I am an expert in analyzing conditions through the agency of stop watch and detail time study. There is no doubt of my ability to increase your output and I am not system-mad. Box 505, AMER. MACHINIST.

Mr. Manufacturer: Your manufacturing staff needs new life. Opportunity presents you, technical man, 19 years' experience, manufacturing, production engineering; holding executive position, manufacturing staff of large electrical works; desires change with manufacturer of electrical apparatus, adding machines or similar lines, superintendent or master mechanic; expert tool design, cost reduction. Box 513, AMERICAN MACHINIST.

OHIO

A young mechanical engineer, now employed, would consider new position paying at least $1200. Broad experience in designing and construction. Location secondary. Box 488, AMERICAN MACHINIST.

PENNSYLVANIA

Superintendent of wide experience with progressive concerns, would like to change. Box 518, AMERICAN MACHINIST.

WISCONSIN

Mechanical engineer (28) wants responsible position as designer of hydraulic turbines. Box 474, AMERICAN MACHINIST.

## Help Wanted

*Classification indicates present address of advertiser, nothing else.*

CANADA

Wanted—Two first-class millwrights for pulp mill in Canada, forty cents an hour. State experience. Box 487, AMERICAN MACHINIST.

COLORADO

An established company about to re-equip and greatly enlarge its plant, desires applications for the following positions: Factory superintendent, capable of taking entire charge of factory doing nothing but fine accurate work, but which must be done at minimum cost; general foreman, assistant to the superintendent; chief draftsman, preferably one with electrical experience; purchasing agent, cost clerk, shipping clerk, foreman for all machine parts departments; foreman for steel-pressing department; blacksmith foreman, who has had experience handling high-grade steels; foundry foreman, who can take entire charge of steel and iron foundry, and who understands the business thoroughly; cost estimator, who has had experience in all departments in this line. In sending applications kindly state fully and in detail all your qualifications, your specialties, if you have any, whom you have worked for, as well as whom you are working for now, salary expected, references and any other information which will help us in judging the merits of your application. The factory is located in one of America's most healthful and best locations and opportunities are limited only by employees' ability. Address Box 481, AMERICAN MACHINIST.

CONNECTICUT

Wanted—Draftsmen who have had experience in designing jigs and fixtures, especially for gun work. Can get favorable position. Box 493, AMERICAN MACHINIST.

ILLINOIS

Wanted—As assistant chief engineer, man experienced as chief engineer or assistant chief engineer, for power plant operating gas engines and steam engines. Give full information as to your experience. Address "C-33," 1300 Trude Bldg., Chicago, Ill.

Experienced machine designer on automatic and special machinery. Preference given to a man with experience on automatic can machinery. Permanent position to the right party. State experience and salary wanted. Box 495, AMERICAN MACHINIST.

INDIANA

Two experienced foremen for machine and assembling rooms, manufacturing gasolene motors. Give reference, experience and age. Box 262, AMERICAN MACHINIST.

Wanted—Machinery department foreman; must be familiar with latest machine-shop practice with ability to design jigs and tools for quick handling of duplicate parts. Model Gas Engine Works, Peru, Indiana.

Wanted—200 skilled workmen for manufacturing gasolene motors; new shop to be open about September 15; give experience and two references; state wages expected. The Western Motor Co., Marion, Indiana.

Wanted—An experienced foreman for machine department, one familiar with screw machines, drill presses, punch presses and milling machines for small accurate work; give reference and salary expected, to go out of city. Box 509, AMERICAN MACHINIST.

KENTUCKY

Wanted—Capable salesman with experience in tank and tower line; must be well endorsed, State age, business history, references and salary wanted. W. E. Caldwell Co., Louisville, Ky.

MASSACHUSETTS

Wanted—Foreman for small machine shop near Boston; man must be capable of introducing up-to-date methods and use of appliances; familiar with the use of high-speed steel, and a good handler of men. "Boston," AM. MA.

Foundry foreman for up-to-date foundry employing 150 men. Will increase later. Produce engines and other standard lines. Want

man experienced in coremaking, mixing by analysis, machine molding and modern methods. Give experience, references and pay expected. Box 494, AMERICAN MACHINIST.

Wanted—First-class designer and draftman on steam and power pumping machinery. Good experience essential. Advise age, experience, education and compensation desired. Box 497, AMERICAN MACHINIST.

MICHIGAN

Wanted—A few first-class toolmakers on small work; good wages and steady employment for competent men. Box 278, AM. MA.

First-class toolmakers, machinists, turret lathe hands, milling machine hands, wanted; some capable of taking charge of departments. Must be A-1 men. Give age, experience, wages, etc. Apply Buick Motor Co., Flint, Mich.

NEW JERSEY

Wanted—First-class machinists who have had shop experience erecting high speed engines. No labor troubles, applicants must state wages desired, past experience and if employed at present. Trenton Engine Co., Trenton, N. J.

Wanted—Draftsmen and detail men experienced in small gas-engine work. Give age, experience and salary expected. Box 496, AMERICAN MACHINIST.

NEW YORK

Wanted—First-class lathe boring mill and turret lathe men accustomed to accurate work. Kerr Turbine Company, Wellsville, N. Y.

Wanted—Toolmaker competent to take charge of a gang of men under the foreman and get good work out. Box 489, AMERICAN MACH.

Competent draftsman, familiar with power presses, for Brooklyn; state age, experience and salary. Address Box 516, AMER. MACH.

Wanted—A first-class foreman to take charge of the manufacture of four cylinder gasolene engines. Address Brennan Motor Mfg. Co., 103 Grape St., Syracuse, N. Y.

Foreman for machine shop employing about 50 men; state age, experience, salary and give references, which will be considered confidential. Box 515, AMERICAN MACHINIST.

Toolmakers wanted; first-class men experienced on jigs, fixtures and fine gages for close small work. State age, experience in detail, and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—A few experienced switchboard and mechanical draftsmen; steady employment. Apply in writing, Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—Man to take charge of machine shop near New York City, employing eight or ten men; must be a first-class, all-around hustler, and willing to work himself. To a man who can fill the requirements there is a chance for advancement. Box 519, AM. MA.

Lathe, planer and boring mill hands wanted for night and day shift; no labor troubles; increasing force; applicants must state wages desired, past experience and if employed at present, to receive further consideration. Apply Ingersoll-Rand Co, Painted Post, N. Y.

Wanted—Energetic man with experience on credits who can systematically manage office in manufacturing patented staple products selling to electrical jobbers and contractors; one who will back his judgment with investment of a few thousand dollars preferred. Address Box 484, AMERICAN MACHINIST.

Superintendent wanted by a company manufacturing gasolene engines. Plant is new, has best modern machinery and an established business. Is located in an eastern central state. This is a rare opening for experienced, reliable man—none other need apply. Address Box 492, AMERICAN MACHINIST.

We require a young man for time study. He should have a fair education and some practical mechanical experience, especially in the machine shop. He must possess an inventive, creative, analytic and tactful mind, willing to study the business and work hard. To such a young man a good future is certain. Box 504, AMERICAN MACHINIST.

Superintendent wanted for large and modern printing press factory. Must be first-class capable man with successful record in this line, able to estimate correctly, know how to handle men to best advantage, reduce costs, have thorough technical training, and good mechanical and executive ability. Only men with the above qualifications need apply. Write fully, stating experience, age, references and salary. Box 506, AMER. MACH.

OHIO

Wanted—One machine shop foreman, acquainted with piece work. Box 517, AM. MA.

Wanted—Mechanical engineer; one who can take charge of drafting and designing machine tools. Must have had extended experience along these lines. Must give recommendations and state former employers and salary received and wanted. Address "Machine Tool," AMERICAN MACHINIST.

Wanted—A thoroughly practical draftsman, one experienced on turret machinery preferred; a master mechanic's position in sight with adequate salary if industrious, competent and progressive; A-1 references required. Address H. B. Lester, Master Mechanic, care Davis Sewing Machine Co., Dayton, Ohio.

Men wanted for automobile factory in northwestern Ohio. Applications wanted for future openings. Machinists, assemblers, toolmakers, molders, machine, bench and floor, millwright helpers, testers, punch press hands, painters, upholsterers. Answering by letter please state rate per hour wanted. Address Box 458, AM. M

Wanted—First-class machinists, lathe planer, drill-press, screw-machine, boring and milling-machine operators, die-sinkers and pattern-makers who are seeking positions or desirous of improving on those which they have,—to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address "Commissioner's Office," No. 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Machinists wanted. Lathe, boring mill and floor hands, air compressor work. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—Draftsmen with experience in designing and checking machinery and machine tools. Location, eastern Pennsylvania. Box 447, AMERICAN MACHINIST.

Mechanical Drawing—An eastern college will have a position open about September 1st for a technical graduate as junior instructor of mechanical drawing. Applicant must state age, education, drawing office experience, with references and salary expected. Box 370, AMERICAN MACHINIST.

Wanted—A good live agent in every shop or factory in the U. S. to sell one of the best known preparations for removing grease and grime from the hands without injury to the skin. Absolutely guaranteed. An agent can make from $5.00 to $25.00 over and above his regular salary. This is no fake. Write for free sample and agents' terms. The Klenzola Co., Erie, Pa.

Wanted—A large machine tool manufacturer desires to employ an A-1 designer. Only such as have had experience on high grade work will be considered. To one who is competent, progressive and of good character an excellent opportunity is offered. State experience, salary expected and give references. All applications will be treated confidentially. Box 465, AMERICAN MACHINIST.

Wanted—An assistant to the general superintendent of a manufacturing company employing about 500 men in the building of hydraulic machinery in eastern Pennsylvania. A splendid opening for the right man, as it is the intention of the present superintendent to soon retire. A man under 40, and one well versed in modern machine shop and foundry practice is desired. Address Box 464, AMERICAN MACH.

Factory accountant and auditor wanted. Young man to take charge of factory accounting system, run it according to schedule, make reports and deductions required by superior officers. Must have held similar position, have general knowledge of manufacturing methods, specific knowledge of modern methods of running his department. Location, Philadelphia. State fully, age, education, experience, married or single, salary desired, when available. Address "Auditor," Box 502, AM. MA

Tool and machinery designer wanted. Young man, technical education, shop experience on press, die and drawn metal work, designing experience on standard tools and special apparatus for rapid production of duplicate work, in touch with latest developments in manufacturing operations, able to work in harmony with manufacturing departments and superiors, design simple and effective apparatus. Location, Philadelphia. State fully, age, education, experience, married or single, salary desired, when available. Address "Designer," Box 501, AMERICAN MACHINIST.

WEST VIRGINIA

Wanted—Some first-class mechanics for lathes, planers and assemblers; best wages paid for best men. None but really first-class mechanics need apply. Address Box 158, Wheeling, W Va.

# For Sale

Purchaser for No. 2 Farwell milling machine, Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 508, AMERICAN MACHINIST.

For Sale—Patents on two automatic machines—one for making screws of all kinds, one for small parts of any kind. Machines can be seen in operation at 16 John St., New York, L. & M. Wollstein.

# Alphabetical Index to Advertisers


| | PAGE |
|---|---|
| Acme Machinery Co. | 120 |
| Adams Co. | 108 |
| Advance Machinery Co. | 102 |
| Almond Mfg. Co., T. R. | 112 |
| American Emery Wheel Wks. | 110 |
| American Gas Furnace Co. | 115 |
| American Pulley Co. | 105 |
| American School of Correspondence | 103 |
| American Swiss File and Tool Co. | 3d cover |
| American Tinol Co. | 94 |
| American Tool and Machine Co. | 121 |
| American Tool Works | 8 |
| American Tube and Stamping Co. | 127 |
| American Wood Working Machinery Co. | 99 |
| Ames & Co., B. C. | 94 |
| Armstrong-Blum Mfg. Co. | 102 |
| Armstrong College | 94 |
| Armstrong Bros. Tool Co. | 125 |
| Automatic Machine Co. | 75 |
| Baker Bros. | 102 |
| Barnes Co., Wallace | 96 |
| Barnes Co., W. F. & John | 14 |
| Barnett Co., G. & H. | 50 |
| Bath Grinder Co. | 83 |
| Baush Machine Tool Co. | 24 |
| Bay State Stamping Co. | 99 |
| Beaman & Smith Co. | 15 and 112 |
| Becker Milling Machine Co. | 23 |
| Bemis & Call Hardware and Tool Co. | 105 |
| Besly & Co., Chas. H. | 124 |
| Bethlehem Foundry and Machine Co. | 114 |
| Bignall & Keeler Mfg. Co. | 102 |
| Bilgram Machine Wks. | 108 |
| Billings & Spencer Co. | 99 |
| Blaisdell Machinery Co. | 109 |
| Blanchard Machine Co. | 111 |
| Bliss Co., E. W. | 25 |
| Blount Co., J. G. | 110 |
| Boker & Co., Hermann | 81 |
| Boston Gear Works | 107 |
| Bradford Machine Tool Co. | 5 |
| Bradley & Son, C. C. | 118 |
| Bristol Co. | 4th cover |
| Brown & Co., R. H. | 112 |
| Brown & Sharpe Mfg. Co., 71 and 4th cover | |
| Browning & Co., Victor R. | 104 |
| Brubaker & Bros., W. L. | 103 |
| Buffalo Fdry. & Machine Co. | 103 |
| Bullard Machine Tool Co. | 49 |
| Butterfield & Co. | 109 |
| Caldwell & Son Co., H. W. | 105 |
| Carborundum Co. | 26 |
| Card Mfg. Co., S. W. | 27 |
| Carpenter Tap & Die Co., J. M. | 96 |
| Carter & Hakes Machine Co. | 109 |
| Carver File Co. | 99 |
| Chambersburg Engineering Co. | 118 |
| Champion Tool Works Co. | 103 |
| Chicago Flexible Shaft Co. | 114 |
| Chicago House Wrecking Co. | 91 |
| Chicago Raw Hide Mfg. Co. | 106 |
| Cincinnati Bickford Tool Co. | 10 |
| Cincinnati Electrical Tool Co. | 101 |
| Cincinnati Gear Co. | 106 |
| Cincinnati Gear Cutting Machine Co. | 128 |
| Cincinnati Lathe & Tool Co. | 103 |
| Cincinnati Milling Machine Co. | 6 and 7 |
| Cincinnati Planer Co. | 14 |
| Cincinnati Shaper Co. | 128 |
| Clark Cast Steel Cement Co. | 117 |
| Clayton Air Compressor Wks. | 109 |
| Cleveland Auto. Mach. Co. | 18 |
| Cleveland Crane & Engineering Co. | 104 |
| Cleveland Planer Works | 94 |
| Cleveland Twist Drill Co. | 4th cover |
| Clough, R. M. | 105 |
| Clum & Atkinson | 117 |
| Coates Clipper Mfg. Co. | 121 |
| Coes Wrench Co. | 16 |
| Colburn Machine Tool Co. | 33 |
| Consolidated Press and Tool Co. | 118 |
| Cook Co., Asa S. | 102 |
| Crocker-Wheeler Co. | 102 |
| Crosby Steam Gage & Valve Co. | 17 |
| Cumberland Steel Co. | 117 |
| Curtis & Curtis Co. | 103 |
| Cushman Chuck Co. | 112 |
| Cushman Electric Co. | 102 |
| Davis-Bournonville | 117 |
| Davis Machine Co., W. P. | 1 |
| Defiance Machine Wks. | 119 |
| Detrick & Harvey Mach. Co. | 109 |
| Diamond Chain & Mfg. Co. | 105 |
| Diamond Machine Co. | 89 |
| Diamond Saw and Stamping Works | 119 |
| Dickinson, Thos. L. | 50 |
| Dill Slotter People | 118 |
| Dixon Crucible Co., Jos. | 117 |
| Dorman, John H. | 109 |
| Dreses Machine Tool Co. | 9 |
| Earle Gear & Mach. Co. | 108 |
| Eastern Machinery Co. | 104 |
| Eck Dynamo & Motor Co. | 102 |
| Electric Welding Products Co. | 117 |
| Electro Dynamic Co. | 101 |
| Elmes Engineering Works, Chas. F. | 103 |
| Errington, F. A. | 113 |
| Evans Friction Cone Co. | 104 |
| Excelsior Needle Co. | 111 |

# Unloading Railroad Cars by Machinery

## A Mechanical Dumping Device That Does away with the Hand Shovel and Puts to Shame the Hopper Bottom Car. A Nature Fake Hog

BY SNOWDEN B. REDFIELD

If railroad cars can be loaded by machinery, why cannot they be unloaded by machinery?

Loading coal and ore into gondola freight cars has been done by machinery for a long time, for we are all familiar with the conveyer and elevator, and the coal chute is among the oldest inhabitants of almost every railroad yard.

Not very long ago the laborer with the shovel for unloading ore and coal cars was partially put out of business by the introduction of the hopper-bottom gondola car. It might almost be said that the hopper-bottom car marked the dawning of a new epoch in the rapid unloading of coal and ore trains, for theoretically all that had to be done was to run a long train of these hopper bottom cars up on a trestle, then to open the doors on all the cars and have their contents drop out onto the piles below the trestle.

This sounds very well, but in actual practice it has been found that the process is slow and that the laborer has invariably to be sent into the car to assist the material out through the bottom door. In the case of freezing in winter the coal and ore have to be dug out with a pick as well as a shovel, and the process is anything but rapid.

### It Picks Them up

Again came the question, if cars can be loaded by machinery why cannot they be unloaded by machinery? The halftones reproduced herewith illustrate one of a pair of car-dumping machines built by the McMyler Manufacturing Company, of Cleveland, and located on the Hoboken, N. J., docks of the Delaware, Lackawanna & Western Railroad Company. Each one of these machines is capable of picking up and turning almost bottom side up any gondola freight car now in existence or liable to be designed for some time to come. This machine picks up the car, carries it upward to a convenient hight, and there literally turns it over almost completely bottom side up, dumping its load down into a funnel-like apron, which directs the material through a chute into a barge underneath, alongside the dock. The material handled at Hoboken is coal, and it is by these machines that the Delaware, Lackawanna & Western Railroad Company transfers its coal from rail to barge transportation.

Fig. 1 is a general view of the north machine, and it will be seen that up in the center of the structure there is a steel hopper-bottom railroad car almost upside down which has just dumped its load of coal down upon the apron and chute leading into the canal boat alongside the dock. The impression given by the photograph is that this car-dumping machine is an affair of some size, and this impression is quite correct, for it is designed to pick up a car which will hold a load of 120,000 pounds, which together with 50,000 pounds for the weight of the car, 85,000 pounds for the weight of the track and cradle which holds the car, makes a total weight lifted of 255,000 pounds.

The record unloading obtained by the Delaware, Lackawanna & Western Company with one machine was 265 cars in

FIG. 1. MCMYLER CAR DUMPER AT HOBOKEN DOCKS OF THE DELAWARE, LACKAWANNA AND WESTERN RAILROAD COMPANY

twelve hours, and during the month of March just past they handled 325,000 tons of coal on the two machines. As a matter of fact the capacity of a machine of this kind is limited by the kind of coal and by the rapidity with which boats can be pulled into place, one after the other as they are loaded.

Here are some records obtained from a similar machine at Toledo: 336 cars were handled by this one machine in a day, presumably twelve hours. Three hundred and twenty-six cars were handled by the same machine between 6:30 a.m. and 4:35 p.m., with 25 minutes lost time waiting for boats. In these 326 cars there were 11,584 tons of coal. Another record is 206 cars holding 6390 tons of coal, unloaded in five hours. The average run for one machine at Hoboken is about 22 to 25 cars per hour; but one record of 42 cars in an hour was obtained on the machine at Toledo.

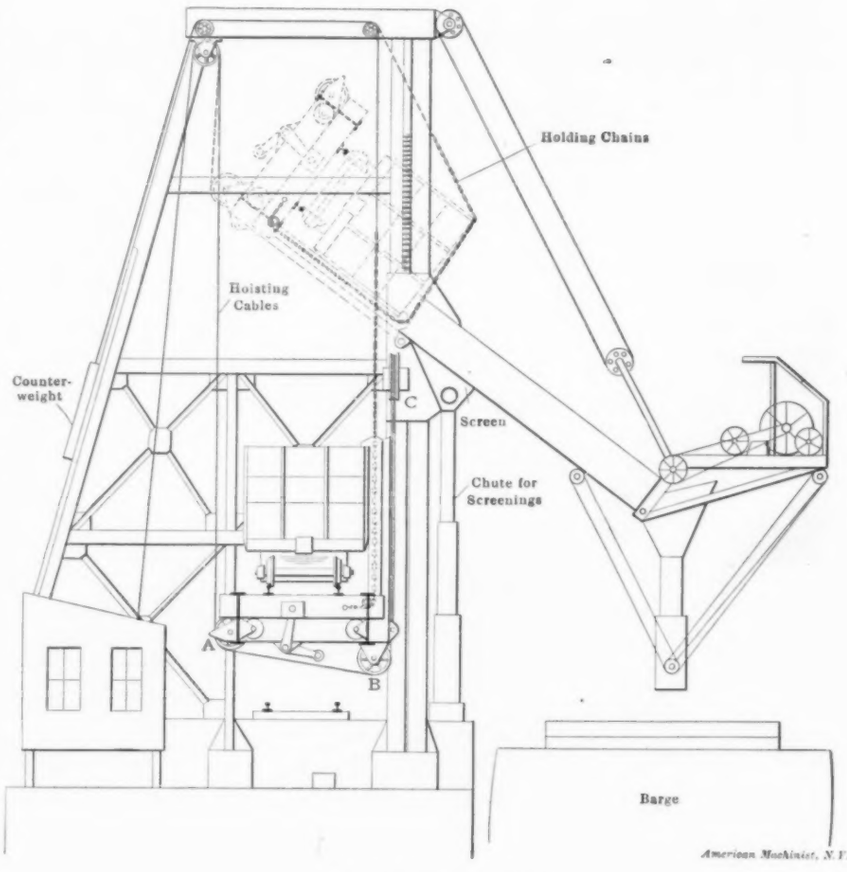



FIG. 4. HOW IT WORKS

### Mule or Hog?

Cars are brought to the dumping machine up an incline, being pushed into place by a small steel car of peculiar shape and designed to push the gondola car up the hill by means of a cable which stretches up the track. The pushing car is of narrower gage than the standard railroad car and consequently there are four rails on the incline. This is illustrated very clearly in Fig. 2.

The pushing car is called by various names, depending upon the locality of its use. In western Pennsylvania, among the coal mines, where one of the principal means of locomotion is the old-fashioned mule, the pushing car is known as a mule. It happens that on the Delaware, Lackawanna & Western docks they call it a hog, or pig. Whether or not the fact that these docks are in Hoboken has anything to do with the selection of this particular name would be difficult to state.

At Hoboken all the power to run the machine, as well as the pig, is obtained from steam, and the canal boats which lie alongside the dock are pulled into place by cables actuated by steam engines on the dock.

After the pig has pushed the car up into

FIG. 2. PUSHING THE CAR UP INTO THE CRADLE

FIG. 3. TURNING THE CRADLE AND CAR

the cradle of the car dumper the cradle begins to rise, lifting the car but without turning it over. The cradle may best be described as a long platform carrying a section of the railroad track. On one side of this platform, that is the side next to the water, or the dumping side, there is a vertical steel wall extending up from the platform. The section of track in the cradle is mounted on rollers in the cradle itself in such a way that the track may slide over about ten inches toward the dumping side.

From this sliding track there extend four heavy chains, which run horizontally from the track toward the water, then around four sheaves in the cradle, and then upward to the extreme top of the machine, where they again pass around other sheaves, and finally down on the slanting side of the machine to four sliding counterweights. The effect of these counterweights and chains is to continually tend to draw the section of track over toward the dumping side of the platform; that is, toward the vertical wall. When the platform or cradle is in its extreme lowest position the section of track is, however, held over to the opposite side in continuation with the rails leading up the inclined plane. This holding is done by two rocker arms, which, when the cradle is at its bottom position, rest upon blocks underneath.

Fig. 7 is a halftone taken from a position half way up the structure, and looking down at the bottom of the cradle while it is in the act of dumping a steel gondola car over toward the right-hand side of the picture. The two rocker arms and their connecting shaft are clearly shown on the bottom of the cradle. The rocker arms are also shown in Fig. 4.

As soon as the cradle has been lifted sufficiently far to relieve the rocker arms from the blocks upon which they rest, the counterweights with their chains draw the track and the car over toward the vertical wall on the dumping side of the cradle. This makes the car rest firmly against the upright wall of the cradle.

As the car further rises, four large steel hooks, which up to this time have been standing over but not touching the car, begin to drop down, and finally hook over one side of the car. These hooks are also on the dumping side. The car continues to rise, still maintaining its normal upright position, but pressed against the side wall of the cradle.

### And Turns Them Over

After the cradle has been lifted so far that the top edge of the upright side strikes against the hinge of the swinging funnel-shaped apron, the whole cradle begins to turn over by revolving about these hinges, causing the car to lean still harder against the upright side of the cradle. This is shown in Fig. 3 where the car is partially turned over. The turning action will be understood when it is said that the hoisting cables coming from the engine house, shown at the bottom left side of Fig. 4, after going to the top of the tower, come down again, pass under sheaves *A* at each end of the cradle at the lower left corners, as viewed in Fig. 4, before turning. From these sheaves the cables pass under the cradle to the sheaves *B*, shown at the lower right-hand corner of the cradle and from thence up the vertical side to other sheaves *C*, located on the under side of the apron. Passing around these latter sheaves the cables once more go downward and finally fasten onto the cradle itself.

It will be understood now that when the hoisting cable is drawn in by the hoisting engine the tendency is at first to lift the whole cradle in its normal upright position, but when the upper edge of the side wall of the cradle strikes upon the hinge of the apron already spoken of, it is easily seen that to continue to draw in the cable will cant the cradle over in a clockwise direction as seen in Fig. 4.

### Also Holds Them In

As the cradle tips over, the chains leading up the right-hand side wall of the cradle, being drawn taut by the counterweights and holding the track and car strongly toward the vertical wall, begin to wind over the top of the car. It is now that the real use for the hooks already spoken of is seen, for the chains are inside of the hooks, and as the car tips

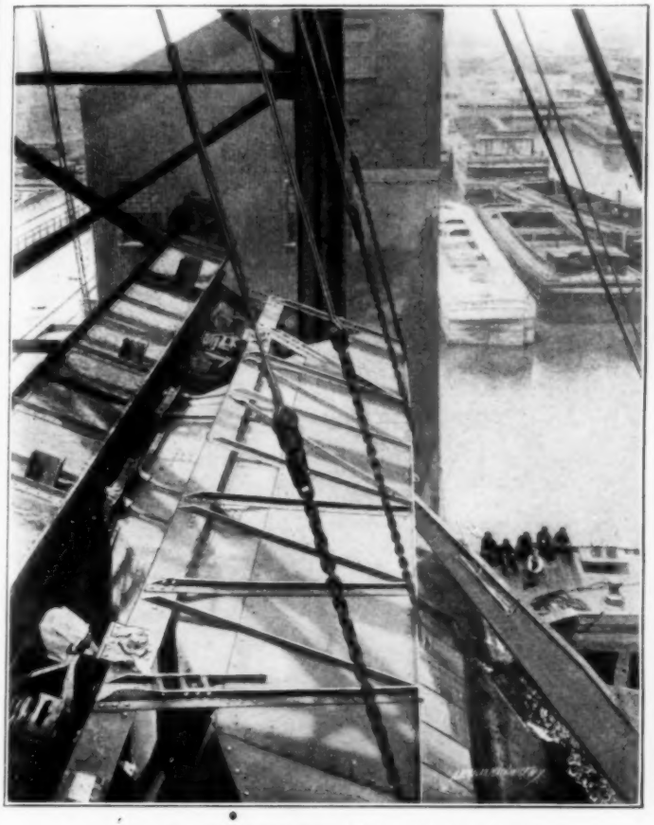


FIG. 5. DUMPING THE CAR, SHOWING THE COUNTERWEIGHTED HOLDING CHAINS

FIG. 6. THE APRON AND CHUTE

and the chains begin to wrap around, these hooks protect the side wall of the car from being crumpled in by the powerful pull of the chains. Fig. 5 is a view looking down upon the overturned car, and the four counterweight chains wrapping around the car are plainly seen. This action which is also shown in Fig. 4, in dotted lines, clearly illustrates how the car is prevented from falling out, as it is literally bound into the cradle by these chains and their counterweights.

In Fig. 5, at the left, three smaller I-beams will be seen to be projecting through the sides of the heavy plate girder of the main cradle. It is upon these I-beams that the section of track rests, and they are mounted upon rollers in the cradle itself, as already described. In the position shown in Fig. 5 these I-beams are drawn down to their extreme position, as the track is held strongly over toward the dumping side of the cradle by the action of the chains and counterweights.

FIG. 7. LOOKING DOWN UPON THE OVERTURNED CRADLE

### No Slack in the Barge

The coal in passing out of the car and down into the funnel-shaped apron, passes over a screen in the bottom of the apron. By means of this screen the slack and fine coal is separated from the larger sizes, which it is desired to load into the barge underneath. The mesh of this screen is adjustable by means of hand wheels, and these wheels may be seen on the far side of the apron in Fig. 5.

Below the screen, that is in the pocket under the screen, there is a worm conveyer driven by a motor, which constantly traverses the slack and fine coal to the further end, where it drops down a chute into a bucket conveyer, which carries it up into a bin in the building shown in the background of Fig. 5. Here the amount of slack is weighed and may then be dumped into other cars and carried off to the power houses, where it is burned under the boilers.

In this way, knowing the weight of a car of coal, the net weight of the car and the amount of slack separated out from the coal in the act of dumping, the net weight of coal actually transferred to the barge is known, and the coal actually loaded into the barge is of the proper size, as desired. For fine coal, which is not screened, the gratings are covered with steel plates and the dumping may be done very much more quickly than when dumping stove or egg coal, for in this latter case the coal must be dumped at such a speed that there will be sufficient time for the screening to take place effectively.

Fig. 6 is a view of the apron and its chute which delivers the coal into the barge. In the upper left-hand corner of the picture are the motor and gear driving the worm conveyer, and also the vertical chute is seen at the far end, which carries away the slack coal from the screen.

### Trimming Ship

On the extension arm of the apron, overhanging the water, there is a protected platform where an operator controls a number of electric switches and hoists. By means of various motors and the cables shown leading downward from this platform the chute at the outer end of the apron may be raised or lowered, or turned inward or outward, with respect to the dock. Also the operator on this platform has control of a sliding gate at the apex of the funnel of the apron, so that he can almost instantly shut off the supply of coal passing through the chute down into the barge. In this way the coal may be loaded into the vessel in piles so placed as to balance the barge

with considerable facility. As surmised, the apron itself may be raised and lowered on its outer end so as to give it more or less slant, depending upon the rapidity with which it is desired to pass the coal over the screen.

### Short or Tall, Thick or Thin

There is another adjustment for this apron, that is, a vertical rising and falling at the hinged upper end. In the exact center of Fig. 5, beyond the far end of the car, will be seen a vertical screw which is about four inches in diameter. This screw passes through a nut near the hinge of the apron, and by turning the screw and its mate at the near end, the vertical elevation of the whole apron may be adjusted. This adjustment in the machines at Hoboken amounts to 30 feet; that is, the car turning in its highest position turns about 30 feet higher than in its lowest turning position. The object of this adjustment is to accommodate the various hights of barges and ships to be loaded.

No matter how high or low the hinged end of the apron may be, the rising cradle always strikes against the hinge when it has been lifted sufficiently far, and begins to turn at this point, so that the side of the inverted car practically coincides with the bottom surface of the apron. The size of the car also, within wide limits, is immaterial as the sliding track and hooks and chains automatically adjust themselves to each condition.

## Making Chasers for Landis Die Heads

Making the chasers for the Landis die head is a different proposition from ordinary die making as the teeth are cut along the blank instead of on the end. This means a milling operation with a mill that has as many sets of teeth as there are teeth in the chaser, and which must also be at exactly the right distance apart if threads with an accurate lead are to be cut. The milling cutters are carefully made to insure even spacing of the teeth as they are a series of circular grooves and not a thread cut along the face of the milling cutter.

It is one thing to cut a milling cutter of the right pitch and quite another to have it of the right lead when it comes out of the hardening bath, so the first step is to consider the amount of contraction that can be expected to take place in the cutter. Careful experimenting and observation has indicated the probable amount of change for the steels being used and this is allowed in the cutting of the pitches.

Assuming that a cutter for a 10-pitch chaser is to be made, 1½ inches long, which will give 15 teeth in the milling cutter. Experience has taught that this length of cutter would contract 0.005 inch. Dividing this by 15 gives a contraction of 0.00033 inch per tooth so that the correct spacing would be 0.10 + 0.00033, or 0.10033. Pretty fine measurements, but at least approximated by the attachment to the lathe, shown in Fig. 1. This is a micrometer stop, working against a multiplying indicator attached to the end of the carriage. This reads to ten thousandths, or "tenths," as they are coming to be called in the many shops, and enables the careful toolmaker to get pretty close to exact dimensions. The micrometer is the regular form, reading to thousandths, and the indicator a 10 to 1 multiplying lever.

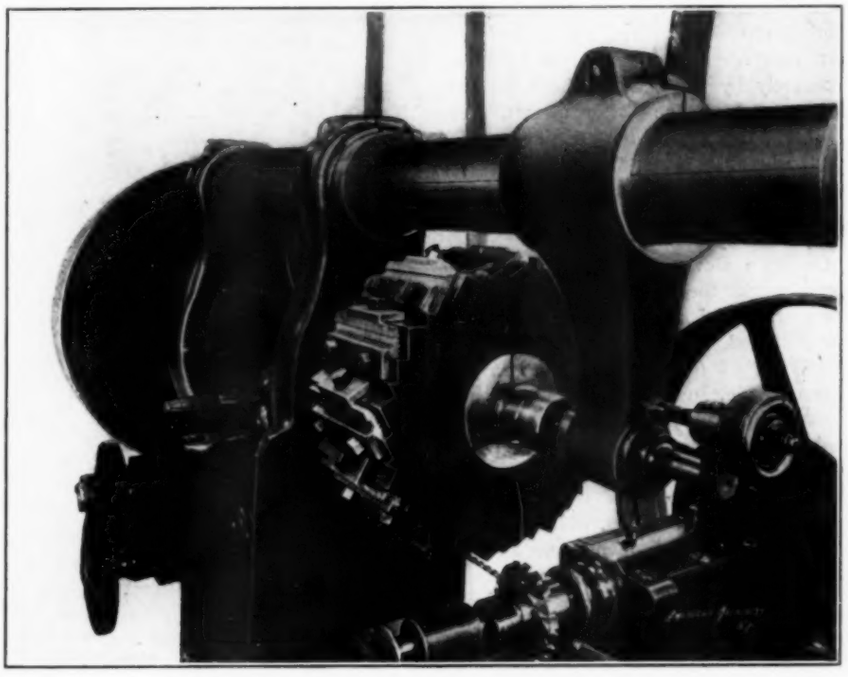


FIG. 2. MILLING OF SLOTS IN BACK OF CHASERS

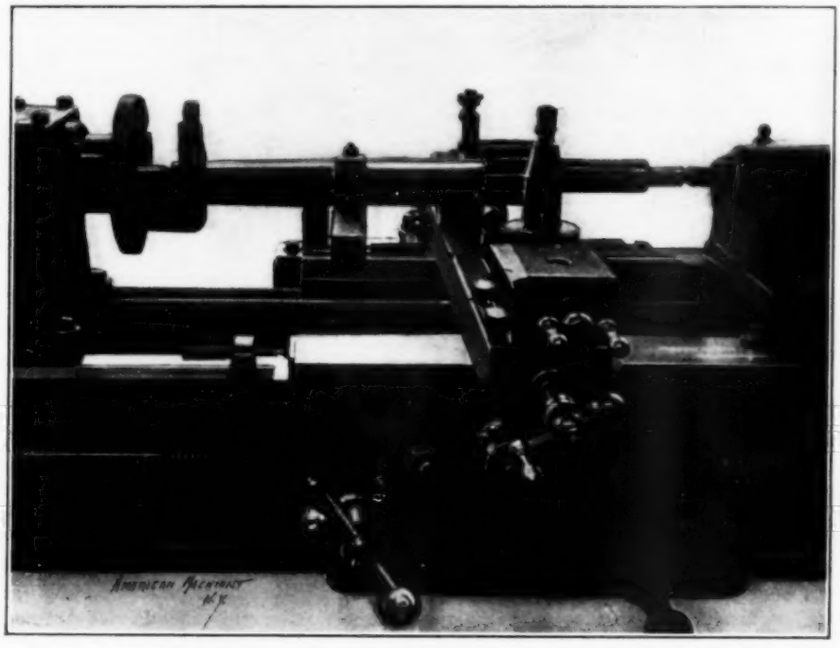


FIG. 1. LATHE FITTED WITH INDICATOR FOR MEASURING PITCH OF CUTTERS

Another interesting operation is the milling of the slots in the back of the chasers, as shown in Fig. 2. These slots have angular sides, one being undercut, and necessitating the work being held off the center to get the desired results with the cutter shown. So the gear cutter was called into play and the magazine fixture shown was mounted on the work spindle. The cutter is made of the right shape to get into the groove when it is up on the side far enough to give the right angles to the sides and to mill the bottom of the sides far enough to give the right of the groove parallel with the face. It is indexed the same as for gear cutting and the operator can easily keep it loaded

with pieces to be milled and take out the finished chasers.

We are indebted to the Landis Machine Company, Waynesboro, Penn., for the illustration, and to their superintendent, H. L. Fisher, for his assistance in securing the necessary information.

## A Divided Molding Frame

By John R. Moorhouse

In foundries where the patterns are carded, a cheap and effective device is to use a divided molding frame, to which is attached the card to be used. By this method a saving is not only made molding them faster, but a card so worked will last longer. When rapped and drawn separately by hand, also where patterns are made from the softer metals, there is less liability of their getting out of shape; because, when used in a divided molding frame, the shaking of the pattern and drawing from the mold are accomplished by the outside frame.

On snap work, using the carded patterns set in the divided frame, castings are quite uniform if the pneumatic vibrator be used, as they are then vibrated alike, and no more than is necessary to insure the clean withdrawal of the pattern. This is most important in small and intricate castings that are to be placed in jigs for machining.

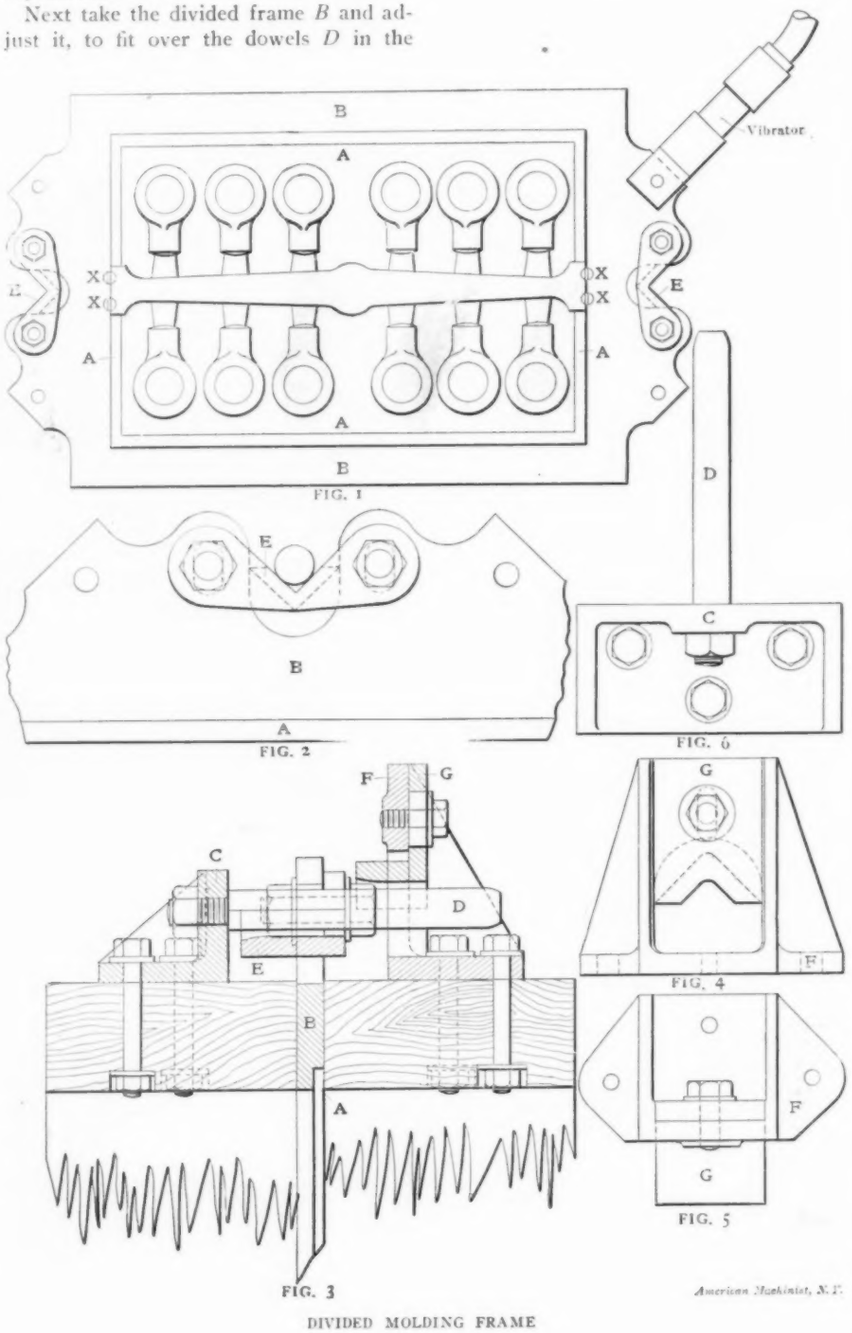
To use the snapflask with a pattern plate on minute castings, difficulty is experienced in keeping them from an overshot joint. No matter how perfectly the snap may fit the plate, previous to going to the foundry, the damp and heat, acting on the lumber of the flask, make a difference in the day's work that shows to a disadvantage on the castings. With the use of the divided frame this small discrepancy is overcome, because the cope is rammed directly off the drag face.

A divided frame with a vibrator attached, is shown in plan in Fig. 1. An enlarged view of the newel, which is adjustable, is seen at Fig. 2. An enlarged section through the combination of the divided frame, with the cope and drag located, is shown at Fig. 3. At Figs. 4 and 5 a plan and elevation of the adjustable newel as attached to the cope is shown, and Fig. 6 shows the elevation of the dowel as attached to the drag part.

Given the size of the snap to be used, a pattern of the divided frame is made to suit. This is preferably cast in aluminum, ½ inch thick, with grooves at *A A*, ¼ inch deep, cast in to receive the card of patterns that is secured to the frame by means of the countersunk screws *X X*, Fig. 1. These can be changed and substituted by other cards at short notice, by the removal of the screws. In the newel plate *E* holes are drilled to permit of their being secured to the frame; elongated slots are also filed in the plates to permit of their adjustment to the dowels on the drag. In locating the dowels *D* and plates *F*, or what are commonly called the pins and ears, to the snaps the dowel *D* is first secured, perfectly square and true to the drag part. The ears *F* are then secured to the cope part; the two parts are placed together, and the socket *G* so adjusted that they slide together evenly, without any slack.

Next take the divided frame *B* and adjust it, to fit over the dowels *D* in the same manner as the cope was treated. Placing the combination together, as shown in Fig. 3, four pieces of iron ¼x1x3 inches are screwed to the side of the drag near the ends, to support a corresponding set of irons on the cope part. This is done so that upon the removal of the divided frame, and the replacing of the cope, the sand will not be crushed or disturbed by any weight that may be brought to bear upon it.

Having now described the construction of the divided frame, it remains to follow with the procedure of working. Assuming the card is located in the frame and the match made to agree with it, the drag part, with the divided frame, is placed upon it and rammed in the ordinary way. It is then removed, turned over, and the cope located upon it. This also is rammed in the usual manner. The runner is then cut; the valve operating the vibrator is opened, usually by the knee, and the cope is raised from off the drag and frame. After this the divided frame is raised and the mold is closed in the ordinary way.




DIVIDED MOLDING FRAME

# A Comparison of American Aeroplanes

## Both Curtiss and Wright Machines Exhibit Individuality of Their Builders—One the Aviator and Constructor; the Other the Aviator and Artist

BY AUGUSTUS POST

A close examination of the Wright Brothers' aëroplane and the "Gold Bug," built by Glen H. Curtiss, will show first a radical difference in size. The supporting surfaces of the "Gold Bug" are but 29x4½ feet, which gives 130 square feet area in each, a total of 260 square feet in both the upper and lower main surfaces of the biplane. The Wright Brothers' aëroplane is much larger; its dimensions are, approximately, 40x6 feet, making each surface contain 240 square feet, and giving a total area of 480 square feet. This is nearly twice the size of the Curtiss machine, without taking into account the surfaces contained in the forward planes used for steering in a vertical plane, which bear about the same relation in point of size.

### Weights

The difference in weight of the two machines is roughly proportional to the difference in size, as one would expect. The Wright Brothers' machine weighs about 1200 pounds with two passengers of 150 pounds each, the machine weighing alone over 900 pounds, including water and gasolene, or a load of about 2½ pounds per square foot of lifting surface. The "Gold Bug," with two passengers of the same weight, would not weigh more than about 700 pounds. Two passengers have not yet been carried, but it is expected that the machine will be able to carry them, though at a slightly slower speed, for the angle of flight would necessarily be steeper, and the surfaces would offer more resistance to the air. This gives a load of 2.6 pounds per square foot of the main surfaces; the front control and the tail add slightly to the total lifting surfaces, but the load per square foot does not vary much from that of the Wright Brothers.

The lighter weight of the "Gold Bug" is obtained by a refinement of construction, the use of bamboo for braces and connecting rods, such as that between the steering planes and steering lever and the supports for the tail, and also by lighter weight in the engine, which weighs only 85 pounds and gives 24 horsepower. The Wright Brothers' engine is a little more powerful, giving 28 to 32 horsepower, but it weighs over 300 pounds. The braces and main structure are made of solid wood, except the ribs of the aëro curves, which are built up from two pieces of thin wood with blocks between, while Mr. Curtiss makes these ribs of laminated wood bent into shape.

### Aëro Curves

An aëro curve is a curved surface in distinction to a plane surface or aëroplane. When an aëroplane is placed at an angle to the direction of its forward motion and made to move rapidly forward, it will either push the air downward or the aëroplane itself will rise if the angle is one in which the forward edge of the plane is higher than the rear edge. In changing the direction of the air current work is done, because of the property of matter which tends to resist a change in its state—inertia. A plane surface will change this direction but once, while a curved surface, approaching an infinite number of small plane surfaces, will change its direction an infinite number of times, therefore doing more work than a plane surface. If this curve is so arranged that it does not curve too much or too little but, in proportion to the speed, exerts a bending effect upon the column of air passing by it without breaking its continuity, the maximum effect is obtained. As a boy skating over thin ice goes just fast enough to allow the ice to bend but not break, in the same manner if a flying machine does not pass rapidly enough over the column of air which supports it the air is allowed to be squeezed out and the machine falls.

There is a slight difference between the Wright aëro curve and the Herring aëro curve, which Mr. Curtiss uses, the latter being a little deeper and, as the surface is not so broad, able to fly at a slightly steeper angle. This one point has much that affects the efficiency of an aëroplane, and upon it rests all the other relative points of speed, lifting power, size and angle of flight. It has an importance somewhat like that of the design of a ship. A. M. Herring's machine, which he has been building for the United States Government, is said to be able to accomplish the same results as these two machines do, but with surfaces only 20x3½ feet.

### Starting and Landing

The next radical point of difference is in the manner of starting and landing. The Wright Brothers have placed skids or runners under the machine for landing, and for starting use a rail about 75 feet long. A tower about 20 feet high is placed in the rear of the starting rail, from which a weight of about 1300 pounds falls. This weight is connected by a rope running over pulleys to the far end of the starting rail and back to the machine, which is placed upon small iron rollers fitting the track. When all is ready a trigger is pulled, releasing the weight, whose fall through the pull on the rope imparts the initial velocity to the machine. It glides smoothly and gracefully down the rail until it attains a speed of about 22 miles an hour; with the push of the propellers the aëroplane gathers sufficient headway for the forward planes to be set at a rising angle, and the machine climbs into the air, lifting itself to an altitude where it may be free from trees, buildings or other obstructions. The Wright Brothers' machine can only climb what would be the equivalent of a 5 per cent. grade for an automobile; in order to rise to great hights it would be necessary to make a large spiral or rise slowly for a great distance. The opposite is true in descending, and should the motor stop, you could glide down to a spot within a radius of about seven times your altitude—in other words, if you were one mile high you could select the safest landing place anywhere within a radius of seven miles. When the wind was blowing, its speed and direction would have to be taken into account. When the operator of the Wright machine wishes to land, he deflects the forward planes slightly and circles lower and lower, if the field is not large enough to allow the aviator to descend in a straight line. Just before the skids or runners touch the ground he shuts off the engine and with one short skip the machine comes to rest like a duck landing upon the water. He can safely land at a speed as great as 40 miles an hour, for the point where the support of the air ceases and the earth takes it up is hardly perceptible.

The "Gold Bug" is equipped with three small wheels, one in front and two under the lower aëro curve. With these wheels, whose wide hubs give them great strength, starting can be accomplished over a reasonably smooth field; as the speed increases and the air takes the burden, there is less and less weight on the wheels until they are free from the ground and are carried by the machine. This extra weight is very slight, and although the head resistance may slightly increase the total resistance, these points are so small that they need not be considered in comparison with the advantages in landing and in

moving the machine on the ground. The Wright Brothers save some weight by the use of their skids, and here again Mr. Herring hopes to save weight and air resistance in more simple construction, for he believes that one skid or runner may be sufficient with a separate truck or wheel for moving the aëroplane on the ground and bringing it to and from the shed. For starting Mr. Herring intends to use a strong elastic rubber band and launch the machine like a catapult, by attaching the pulling device to a stake some 150 feet in front of the starting point of the aëroplane. This would undoubtedly simplify starting and landing if it would not bring about other complications.

### Front Control and Rear Rudders

In both the Wright Brothers' machine and the "Gold Bug" the forward planes are much alike, that is, they bear the same proportion to each other as far as size of surface goes, that the machines themselves do, and the relative position is nearly the same. If anything, the Wright Brothers' may be slightly larger. Their method of deflecting or changing their angle is different, however, and very characteristic, for they change the curve of the surfaces as well as the angle by a most ingenious arrangement of the struts connecting the two surfaces. Mr. Curtiss has a rigid box-kite structure, and simply changes the angle in order to raise or lower the machine and steer in the vertical plane.

The rear rudders are different; the "Gold Bug," besides its ordinary vertical rudder for steering in the horizontal plane, has a small horizontal tail, the remains of a large box-kite tail that was used on the first machines built by the Aërial Experiment Association, of which Mr. Curtiss was a member. This association, under the guidance of Dr. Alexander Graham Bell, built the first machines of this particular model, these machines being in order: a glider; the "Red Wing;" the "White Wing;" the "June Bug," winner of the *Scientific American* prize; the "Silver Dart;" and lastly, the "Gold Bug," built by the Herring-Curtiss Company and winner of the *Scientific American* trophy for the second time unless its record of 24.7 miles is excelled by some other machine before the end of this year. The evolution—the slight changes, improvements, growth of refinement to the present state and to standard lines of construction—is very interesting. The influence of other minds and of other machines is also visible; the machine as it now stands is of the Chanute-Herring glider shape, which was very like the truss form of construction used in the early Wright gliders. In contrast to this gradual evolution, the Wrights established their model at first, and have made almost no change since. This is the standard biplane construction, and is used in preference to the monoplane.

### Control of Equilibrium

This leads directly to the most marked and interesting feature of the Wright Brothers' machine, the one thing that has put them so far ahead of all others, and seems to be one of the most characteristic elements in all their structures. I refer to their arrangement for changing the degree of curvature of the tips of their aëro curves, or warping the supporting surfaces of their machine at will, making them have a greater or less lifting power on one side than on the other for the purpose of righting their machine in case it tips or tilts too much to one side. This is done by having the outer portion of the rear edge flexible and connecting the rear corners on opposite sides, so that pulling the corner down on one side will correspondingly raise that on the other side, changing the curve of the outer portion of the surfaces and acting as a couple tending to right the machine. The side that tilts down too much is made to curve more and hence to lift more, while the opposite and high side is flattened out and its lift correspondingly decreased. This method of controlling the equilibrium is unique with the Wright Brothers, and is the basis of their most valuable patents, enabling them as it does to combine in one structure most efficiently what is done in other machines by means of small auxiliary planes, wing tips, and less perfect methods of accomplishing the same result.

Mr. Curtiss has small planes mounted at each side of his machine between the main supporting surfaces, which are hinged at the front edge and connected to each other and also to a yoke that engages the shoulders of the aviator so that when the machine tilts to one side, the natural impulse being to lean toward the high side, this yoke is moved and the angle of the planes so changed that the one on the lowest side tends to lift and the one on the high side to push down, which quickly rights the machine. Mr. Curtiss has told me that this action on his machine has not given quite as quick or sensitive a response as he would like, and that several times the side control had been as far over as it would go with but sluggish effect, while the front control, on the other hand, was very sensitive, responding so quickly that though he did not dare to let it go entirely he could keep it on an even course just by resting one finger on it. Mr. Curtiss has also said: "Driving an aëroplane does not involve the severe strain on one's nerves that many people seem to suppose. I find it to be quite easy, and surely the most delightful sport I ever had. In my flight this morning I really experienced no greater nervous strain than I would have felt in driving an automobile at good speed for the same distance, but, of course, conditions this morning were good."

### Motors

The heart of a flying-machine is its motor, and like the human heart, it should act with the utmost regularity and reliability. Light weight is important, but reliability is the most necessary element in construction. The Wright Brothers, in accordance with another of their characteristic ideas, were not satisfied until they had built their own motor and knew all there was to know about every part. Although others might have built for them a better engine, or made some refinements in the weight and finish, they had plenty of lifting power to spare for the motor and good control, so they had no difficulty in flying.

This thorough knowledge of the motor, which is gained only through making it, enables you to know just what part has been made lighter, just where you have pressed the limit, and from every little sound, just what is going on with the cylinders and crank case. One morning when Mr. Curtiss was flying over the Hempstead plains he felt almost instinctively that the engine was not responding properly and knew it was not yielding its full power. Out of some 1200 sounds of the exhaust per minute he could tell that the rear cylinder had lost compression. Descending at once, he told what the matter was and had the machine wheeled back to the shed, where upon taking off the rear cylinder it was found that the top of the piston had caved in, destroying the compression—which is rather high in this engine, about 85 pounds per square inch—and hence materially cutting down the full power. Mr. Curtiss knew that this place had been weak, and had prepared new pistons, a little heavier, for just this emergency; and to show how delicate is the balance of the engine, before putting on the new pistons they were taken to a drug store, weighed upon the apothecary's scales, and filed down until they were perfectly equal and balanced each other in the scale pans.

If a novice should have to run such a light engine, and one so delicate and sensitive, should anything go wrong it would take a long time to find out the trouble, especially where it is not merely running the engine, but getting its full power delivered. The Wright Brothers want to know their engine so thoroughly that it will seem to run in their minds and they will be able to appreciate the action of every moving part as if they could see its workings through the inclosing metal. The Wright Brothers' engine is water-cooled, and has magneto ignition with exceptionally large valves in the cylinder heads mechanically operated by rocker arms. The engine of the Curtiss machine is the first water-cooled motor that he has built, excepting the one built for Captain Baldwin and used on the dirigible that he delivered to the War Department last year.

This engine is in many respects superior to the Wright Brothers' engine, for it is lighter in weight, weighing a little over 90 pounds, including magneto, pumps and carbureter. The radiator weighs 40 pounds, and when supplied with water and oil the weight of the entire power plant is about 150 pounds, while the framework and supporting structure weighs but about 250 pounds more. The present gasolene tank on the "Gold Bug" holds four gallons, sufficient for an hour's run; the Wrights carry fuel in their tank sufficient for 125 miles.

### Fabrics Covering the Planes

There is a great difference in the materials used to cover the surfaces of the two machines. The Wright Brothers use a rather heavyweight cotton cloth, with which they cover both sides of each of the supporting surfaces. This leaves a small air space between the top and under surface of each wing, within which are the ribs.

In the Curtiss machine the material used is silk covered with rubber and vulcanized so that it will be impervious to the passage of air. This material is fastened to the upper side of the ribs by a band of featherbone tacked over them; the front edge is wrapped over the frame and the rear stretched tight by a wire extending from one side to the other through a hem in the cloth and attached to the end of each rib. The material is fastened by sewing and gumming the edges together with pure rubber cement, and in places by shoe eyelets. There may be some small advantage in air-tight material for the wing surfaces, and there may be also a slight difference in the skin friction of different materials; when the speeds become greater and the pressure per square foot increases no doubt these points will become of more importance.

### Propellers

Another essential point of difference is in the number of propellers, their shape, and the way in which they are driven. The Wright Brothers have studied this question very fully and have, perhaps, as complete data upon this important point as any of the other experimenters in the field; they claim to be able to design a propeller that will give its highest efficiency at the speed at which it is to travel through the air. This is one of the reasons why they use an auxiliary starting device, for while they could design a propeller that would give sufficient thrust to enable them to start from a condition of rest, this propeller would not be quite so efficient when the aëroplane was traveling at full speed through the air.

It is hard to attain the ability to construct in the mind the conditions that exist around and in the disturbed field of the atmosphere about the blades of a propeller traveling forward in the air and revolving with a peripheral speed of nearly 90 miles an hour. The study of a propeller in water is the nearest to studying a propeller in air, although as water is 800 times denser than air, the speed of revolution in air is so much greater than in water.

The Wright Brothers use two propellers, chain driven, the chains running through metal tubes to guide them and to insure that they will not vibrate and jump off the sprocket wheels on the engine and propeller shafts. The propellers make about 350 to 400 revolutions and give about 140 pounds thrust each, although it needs much less than this amount to fly. They have a peculiarly shaped blade, caused by cutting off one of the corners, for the Wrights explain that as this small area cuts the air at a greater speed than any other area and offers more resistance to the air than it exerts thrust, they cut it off. Their propellers seem to revolve slowly in comparison with the propeller of the "Gold Bug," which makes 1200 or 1300 revolutions, nearly twice the speed. The propeller that is now used is a two-bladed one, and has a diameter of 6 feet, and is 6½ inches wide with a 5-foot pitch, which means that it would advance 5 feet for every revolution if there were no slips—in other words, if it should revolve in some unyielding substance. The ends are rounded and it is cut out of a single block of laminated wood. It seems curious that you can take two propellers and make them identical and by the use of templets exactly the same in every respect as far as mechanical skill is able, and yet a practical test will obtain different results from each one.

With a propeller made by the eye with a draw knife a larger thrust has been obtained than from those laid out by calculation at the Curtiss factory at Hammondsport. The "Gold Bug's" propeller is fastened directly to the engine shaft by six bolts which clamp it to a flange just outside the rear engine bearing. This is the best way to fasten a propeller, and the closer you can get to the engine the better, thus eliminating long shafts, gearing, or other opportunities for loss.

It is difficult to compare the relative advantages of the Wright and Curtiss propellers; they both seem to do the work required, and have been designed especially for their particular requirements and special conditions.

The flying machine still represents the personality of the maker, so that a comparison of the Curtiss and Wright aëroplanes is less a comparison of two machines than of two works of art. Each has such marked characteristics that it is easy to determine the source of its inspiration. The machines represent the individual thoughts of the makers, so that a comparison of the machines is in effect a comparison of the individuals themselves. Mr. Curtiss shows his previous education in construction, gained from building motor-cycle engines, while the Wrights are clearly following in the footsteps of the more artistic Lilienthal. The Curtiss aëroplane is a flying machine; the Wright is a flying man.

---

## A Short Cut for Figuring Circumferences of Circles by Long Hand

By L. E. Dudley

While the slide rule is about the quickest way of finding a circumference from

*Circumference* = *diameter* × 3.1416,

it is often necessary to figure it out accurately; and then, too, all of us do not have slide rules.

At a place where a large number of circumferences had to be figured out accurately, and where the boss insisted on it being done by the long-hand method, I used the following system which cut out all actual multiplication, reduced the chance of error, and enabled me to find the circumferences by the use of addition only. I simply made a set of multiples, of $\pi$ to the fourth decimal place, ranging up to 9, and laid it on the table in front of me and instead of using the diameter as the multiplicand, I multiplied 3.1416 by it—the way the actual multiplication was cut out is shown by the following example:

$$1 \times \pi = 3.1416$$
$$2 \times \pi = 6.2832$$
$$3 \times \pi = 9.4248$$
$$4 \times \pi = 12.5664$$
$$5 \times \pi = 15.7080$$
$$6 \times \pi = 18.8496$$
$$7 \times \pi = 21.9912$$
$$8 \times \pi = 25.1328$$
$$9 \times \pi = 28.2744$$

MULTIPLES OF $\pi$

To find the circumference of a circle with a diameter of 472.63, we simply take the multiples from the table and arrange them thus, starting with 3, then 6, then 2, etc., and add and point off:

| | |
|---|---|
| 3 | 94248 |
| 6 | 188496 |
| 2 | 62832 |
| 7 | 219912 |
| 4 | 125664 |
| | 1484.814408 |

Thus,

$$3.1416 \times 472.63 = 1484.814408,$$

the required circumference.

Any circumference can be found by the same method, and with an adding machine handy it's a "cinch."

# The Growth of the High Speed Engine

On Tuesday evening, May 11, an abstract of a stenographic report of a lecture on "The Growth of the High Speed Engine, or The Straight Line Engine in Particular," by Prof. John E. Sweet, was read before the Modern Science Club, of Brooklyn, N. Y. Thirty-five lantern slides were used. Professor Sweet was not present. An animated discussion followed the reading of the paper, which was in part as follows:

### Professor Sweet's Paper

In treating of this subject I shall, both from necessity and choice, rely entirely upon my memory. Just who built and ran the first high-speed engine would be hard to determine, because it turns upon what we call high speed in revolution and what we now know as high speed originated in about this way:

At the time when Charles T. Porter was building steam-engine governors, Mr. Allen, who was later associated with Mr. Porter in building the Porter-Allen engine, conceived the idea that he wanted an engine with a positive valve motion that would give the results of the Corliss engine.

In their natural intercourse, Mr. Porter suggested to Mr. Allen that with his valve motion the engine could be run at a much higher speed. Mr. Allen had not thought of this, nor taken to it very enthusiastically. Mr. Porter worked out the idea, and among other things had built and exhibited one of their engines at the London exhibition of 1862, where he astounded the English engineers by the speed at which it ran, although it was what we would now call moderate speed.

At that time I was a draftsman in the international patent office, London, and traced on parchment the drawings of the Richards indicator (of which Mr. Porter had charge). I believe I saw Mr. Porter, although I did not make his acquaintance. However, we met at the Paris exhibition, where Mr. Porter exhibited five engines built at the Whitworth works in England. The largest one, 12x24 inches, ran a portion of the machinery, and at the speed of 250 revolutions per minute, if I recollect correctly. This engine had a condenser of Mr. Porter's design, in which the pump plunger was connected directly to the tail end of the piston rod, and although running at that high speed, which no engineer but Mr. Porter believed could be made serviceable, the engine worked quietly and successfully. The secret was in making the end of the plunger pointed and running it under water.

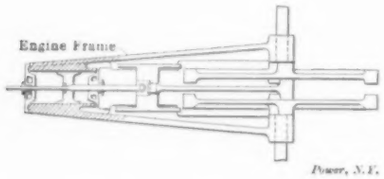



FIG. 1. FIRST PENCIL SKETCH, LATE IN 1860

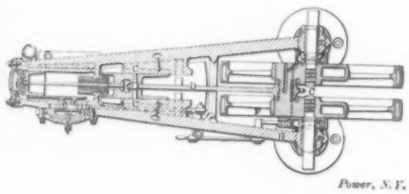



FIG. 2. HORIZONTAL SECTION OF FIRST ENGINE

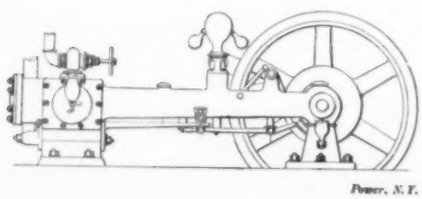



FIG. 3. ORIGINAL ENGINE, FLYBALL GOVERNOR

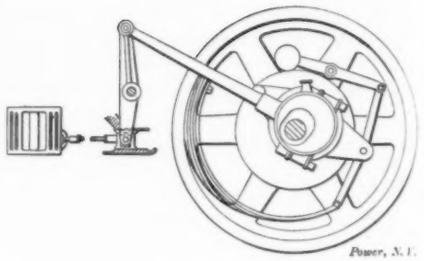



FIG. 4. CENTRIFUGAL GOVERNOR WITH ROCKER

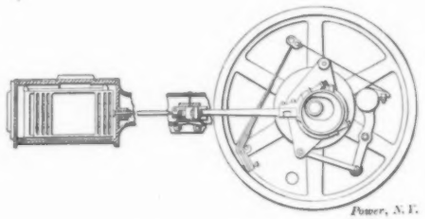



FIG. 5. GOVERNOR WITHOUT ROCKER

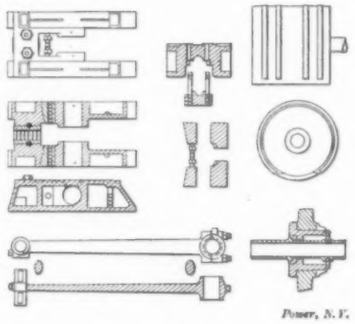



FIG. 6. PISTON, CROSSHEAD, ROD AND LONG SLEEVE

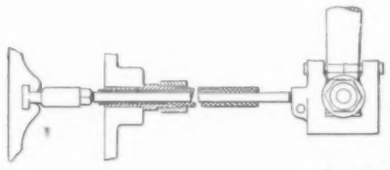



FIG. 7. PACKINGLESS VALVE STEM

Of the four other engines, all I think 6x12, one ran at a terrific speed. The attendant told me that they were going to run it at 1000 revolutions, although I do not know what Mr. Porter expected to do, or did do, but anyway it went fast enough. Mr. Sprague says 1500 or 1600 but I don't believe it. Two were running dynamos for lighthouses, and another was a complete engine with one-fourth of the cylinder and steam chest cut away, driven by a belt to show the action of the valves, piston, etc. This was repeated by the Buckeye Engine Company many years later.

On Thanksgiving day, 1870, I started on the drawings for the first Straight Line engine, Figs. 1 and 2, and finished and started the engine on the first day of April, 1871. This engine had a varied experience, and for the last 19 years has adorned, or disfigured, the present Straight Line engine works. See Fig. 3. In the meantime Mr. Porter had come to New York, built a shop at Harlem, and was in the engine business, building and selling the Porter-Allen engine.

While at Cornell, in 1875, with only student labor, we built the second Straight Line engine and had it on exhibition at the Philadelphia Centennial. This engine had a shaft governor which was then, perhaps, the second or third one ever shown in this country. Mr. Hoadley's and Mr. Tabor's were earlier, and the Hartnell, of England, earlier still. Patents had been secured before, but I do not recall that any were so far advanced as to call general attention to them.

In the fall of 1879 the third Straight Line engine was built. In February, 1880, the Straight-Line Engine Company was organized, a name given to the engine, and the first one built by the company (see Fig. 13) was started the first of July of that year. This engine is still running at the Lakeside power house in Syracuse, N. Y.

At the Centennial there were shown three or four electric generators or "dynamos," as they were called then, and the one we had built at Cornell, the first Gramme machine built in this country, was shown driving an electric light, but such only as could be used for a lantern. Electric lights up to that time had been

used only in lighthouses and lanterns. That fall electric lights were placed on the campus at Cornell, and others, to some extent, in the East.

The growth of the electric light and the growth of the high-speed engine came on together. The electric people have often claimed that the electric-light business built up the high-speed engine, but there are two sides to that story.

In the early days there was a good deal of flicker in the lights and the electricians claimed that it was all due to the unsteady speed of the engine.

We furnished an engine for the Brush people and after Mr. Brush and his superintendent worked a half day testing out a 40-arc-light machine, Mr. Brush decided that the greatest variation was one turn in two minutes, and that led them to "sit up and take notice" and settle that the flicker was due to imperfect carbons. The better-governed engines helped out the electric people.

The slow-speed Corliss engines varied so at each revolution that the speed of the engines could be counted anywhere the lights were in view.

The next engines that bid for favor

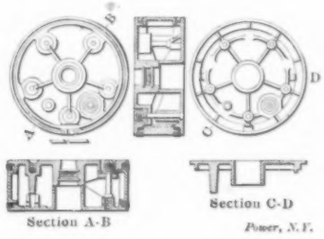



FIG. 11. POP PISTON

among the electric people were the Armington & Sims and the Ball. I think the Armington & Sims first, as they seemed to have a pull with Edison and were the first to make great progress.

The Ball builders made great claims for their governors, but they have changed them three or four times, while ours is practically the same as that used in the first engine built by the company, 29 years ago.

The Straight Line, Armington & Sims and Ball engines were center-crank, shifting-eccentric shaft-governed; ours a single ball; the Armington & Sims two balls, and in the Ball the governing was partially centrifugal and mainly by an ingenious arrangement whereby the eccentric was shifted by the load.

Soon after the four engines mentioned came the Payne, Ide, Westinghouse, Skinner and others.

The Porter-Allen and the Straight Line valves were mechanically fitted flat valves, depending on the mechanical fit for tightness. The Armington & Sims and Westinghouse piston valves and the Ball used a partially balanced valve.

At the Centennial the Buckeye Engine Company exhibited a small engine, such as they coupled direct to a circular saw, and ran it at a terrific speed. I think they said 400 turns a minute. It was something like a 6x12 or larger, and the saw of such size as is used for cutting lumber.

The Westinghouse two-cylinder single-acting engines were short-stroke, and ran at high speed, likely faster than any of the others, and as far as numbers were concerned the Westinghouse people turned out twice as many as any other builder, although possibly not as far as electric lighting was concerned. They were the first to adopt the inclosed crank case and splash oilers, and the first to introduce compounding. The continuous system of oiling with pump and filter was intro-

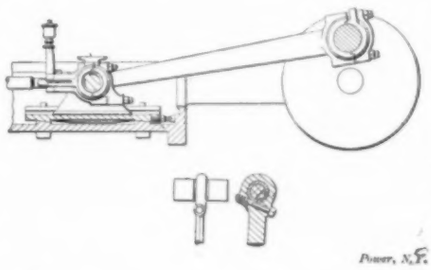



FIG. 8. LONG CROSSHEAD AND SHORT GUIDE

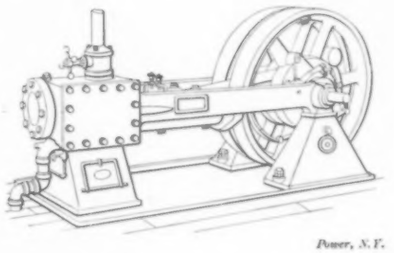



FIG. 9. PRESENT ENGINE, COFFIN THROTTLE; ABSENCE OF FOUNDATION BOLTS AT CYLINDER END

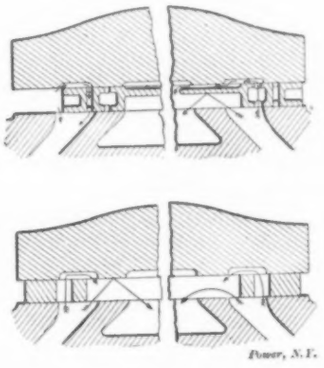



FIG. 10. COVER PLATE AND BAFFLE IN VALVE

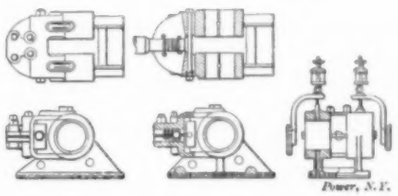



FIG. 12. PRESENT CROSSHEAD

duced later, and I think by steps, but by whom first I do not recall.

J. C. Hoadley, who was the first, no doubt, to introduce the shaft-governed shifting single-eccentric in this country, determined by experiment that to have the engines run quietly from 10 to 14 per cent. clearance was necessary, and Bourne and Auchincloss that it was not possible to use the shifting eccentric and maintain a constant lead to the valve at both ends of the cylinder. This led me to "monkey" with the rocker arm and design the corrected valve motion which did maintain a constant lead at both ends of the cylinder.

Experimenting with our earliest engines showed me that a constant lead was exactly what we did not want, but a variable lead; and when we got the variable lead I became convinced that the constant lead was not worth the distorted rocker arm that it took to get it. See Fig. 4.

By the change from the original form of approximately constant lead to the variable lead, we were enabled to reduce the clearance to one-half of the amount Mr. Hoadley had established, and as the clearance is one of the sources of loss,

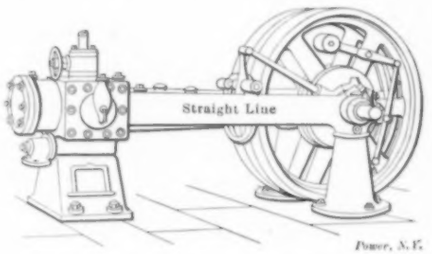



FIG. 13. ENGINE WITH ROCKER ARM FOR CONSTANT LEAD

the new arrangement not only enables us to run quietly at a wide range of load, but much more economically. See Fig. 5.

While great stress has been laid on the superiority of the Corliss engine, and justly so, this gain in economy by the change in the valve motion did not give our engine the trade; and this, perhaps, because of a lack of able salesmen.

But there are in the small electric-light business three essential things that come in before economy. The most essential of all being that the engine must go, and with the briefest possible stop—when a stop is imperative. The engine must govern on the widest variation of load, and the engine must be quiet and in many cases practically noiseless. The question of steam consumption sometimes does not come in at all, on account of heating the place.

This history has extended over a period of about 45 years. No one can realize the amount of study and experimenting that has been given to the development of the subject. The experiments we have tried, and found to fail, far exceed the successes and, as Edison says, "No failure is a loss, because you learn something;"

so we have learned a lot of things that don't work as well as we could have hoped.

We tried long pistons, Fig. 6, which all said was right, but they did not do well; too many got to cutting. We tried various kinds of piston rings until about 1888, when the limited expansion which we now use was designed. Mr. Porter's four-opening double valves with very short travel have eight chances for leakage, aggravated by the small lap. We cut it down to one valve, with two chances for leakage and long travel and wide lap, which is better, but none too good.

The compensating-pressure plate was too complicated. For the various steam-chest and cylinder-head joints, the narrow band, metal-to-metal, is the thing; also, the round rod in a reamed hole for piston and valve rods; the bushes, from wood to cast iron. Babbitt is best in some places, and lead bronze in others, Fig. 6.

Six or eight kinds of crossheads and guides; two or three different kinds of attachments of crossheads to rods; three or four kinds of takeups on crosshead pins; three or four crosshead pins; three different styles of frames; solid and bushed cylinders; three or four modifications in the design of the governor; three kinds of governor, before the final design, Fig. 5; three kinds of main boxes; two or three throttles before John Coffin's, Fig. 9; two distinct forms of cross-section of the various parts; and a half hundred direct-connected bases; certainly as many, if not more marked departures from general practice than on the part of other builders.

The original characteristic features of the Straight Line engine were the straight two-arm frame, three-point support, Fig. 1, ring oilers, flywheels on the throws of the crank, Fig. 2, single-ball governor, Figs. 4 and 5, absence of packing on piston and valve rods, Fig. 7, end play to all journals, long crossheads, Fig. 8, and short guides, limited expansion piston rings, the absence of foundation bolts, Fig. 9, baffle plates in valve, Fig. 10, Coffin throttle and pop piston, balancing pockets in rim of flywheel, Fig. 2.

It is for us, whose shadows are growing fainter and fainter, to anticipate what is to be the final outcome of our fighting this battle for the high-speed engine. Grass grows up and dies down; trees grow and die; dogs grow and die; and man suffers the same fate. Countries spring up and flourish and fade away, and astronomers tell us that the moon is dead, and that there are dead stars. Each and every one of the old slide-valve engines has had its day, a thousand rotary engines have died "a-borning," the turbines are spinning, and the glory of the Corliss engine is waning.

The high-speed and gas engines started together. The gas engine has matured much more slowly, and is about to have its innings. The high-speed engine is changing its coat, and must share the fate of everything else. It has served its purpose, proved its right to existence, been useful, and if it goes down with the Corliss engine it will die in good company.

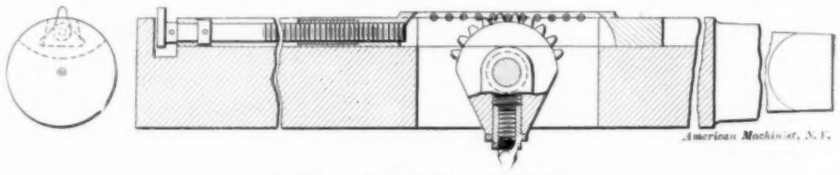
## Boring Bar for Ball Sockets

By H. C. Williamson

The accompanying line cut shows a sectional view of a boring bar for boring ball sockets in pedestals and pillow blocks for self-aliming bearings. This bar has been used on several kinds of work and under adverse conditions has always proved satisfactory in every respect.

The bar is turned with a shank on the end to fit the spindle of the machine in which it is to be used or it may be left straight and driven with a carrier, by holding the bar between centers. When the bar is held in the spindle of a machine it should always be supported at the outer end by a center.

There is a transverse slot cut through the center of the bar, rectangular in section; the length and breadth depending on the size of the bar. At right angles




BORING BAR FOR BALL SOCKETS

to this slot and through the center of the bar is drilled and reamed a hole for the pin on which the segment works. The location of this slot depends upon the job to be done, and is so the center of the pin, mentioned above, will come directly over the center of the socket to be bored.

Near the end of the bar another slot is cut for the star feed to work in. This is shown at the left-hand end of the sectional view and in dotted lines in the end view. The number of points on the star will depend on the pitch of the screw used.

A dovetail slot is cut lengthwise of the bar. This extends from the slot in which the star feed works to several inches beyond the slot in which the segment works. In this slot is fitted a slide which works the segment through a rack. The front end of the slide is bored out to receive the brass nut, which is forced in, and a hole about 1/32 inch larger than the screw is continued through the slide. In the center of this slide is cut a slot, the width of the face of the segment.

Where the pitch diameter of the segment touches the slide, draw a straight line and this will be the pitch line of the rack. To simplify and cheapen the cost, pins may be used for the teeth of the rack instead of cutting teeth in the slide. The distance between the centers of the pins equals the circular pitch of the segment, and the diameter of the pins should be a little less than the thickness of the teeth in the segment at the pitch line.

The segment, which is made of cast iron, carries the tool and is turned at one end to the radius of some convenient gear and the teeth cut to standard size, about 180 degrees of teeth is all that is required. The face of the segment is made the width of the slot in the slide and the body which holds the tool is the same width as the slot in which it works in the bar.

It is best to bush the hole in the segment as a bushing can easily be renewed when worn. In the end of the segment a hole is bored and chased out to receive a thimble, that has a threaded hole in it, in which is screwed the tool. The hole in the segment is chased with a left-hand thread and the hole in the thimble has a right-hand thread. With this arrangement the tool may be adjusted to any desired length by holding the tool and turning the thimble. Lock nuts are provided to fasten the thimble and tool securely to the segment.

At the end of the dovetail slot, where it meets the slot for the star feed, is fitted a block which is held by pins; this block provides thrust for the feed screw, the hub of the star feed on one side, and a collar held by a set screw on the other.

The pin on which the segment works should be a neat fit as any lost motion in this will show in the work done by the bar. The end should be threaded for a nut to take up lateral play.

---

An enormous freight train was recently moved over the Pennsylvania railroad from Altoona to Enola, Penn., according to the *Engineering Record*. The locomotive was a H-8-b. engine built at the Altoona shops, and has a tractive capacity of 42,661 pounds. There were 105 steel cars in the train, loaded with 5544 tons of coal. The entire train, including the engine, caboose and cars, weighed 7644 tons, and it stretched along the track for more than two-thirds of a mile. The test was made on a 127-mile track having a grade at no point greater than 12 feet to the mile. The locomotive hauled the train over this distance in 7 hours and 12 minutes, or at an average speed of 17.6 miles an hour, which is probably a record performance for a single locomotive.

# Efficiencies of Various Cut Gears

## Apparatus Used and Results Obtained in Testing Automobile Spur, Bevel, Worm and Crown Gears. Characteristic Curves for Each Kind

BY G. EVERETT QUICK

Although toothed gearing is one of the most familiar devices used in power-transmitting machinery, very few authentic data are available on the efficiencies of the different tooth forms, pitches, finishes, etc. This is not entirely to be wondered at when one realizes the difficulties met with in striving for even a reasonable degree of accuracy. This is apparent to even the inexperienced reader by merely reading the report of the methods used and results obtained in an extensive series of gearing tests made by Wilfred Lewis and published in the *Transactions* of the American Society of Mechanical Engineers (Vol. VII). The great number of varying values from which an average value was obtained is shown on the plotted curves.

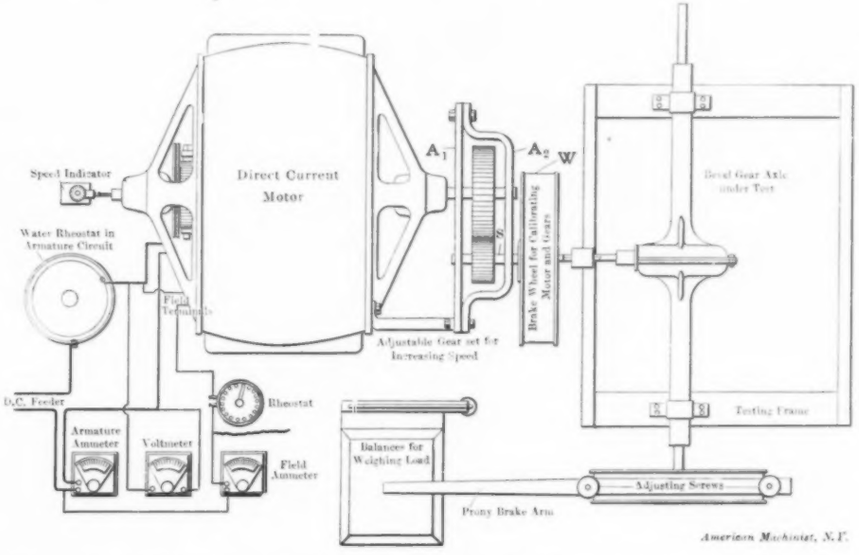



FIG. 1. ARRANGEMENT OF APPARATUS FOR TESTING GEARS USING A CALIBRATED MOTOR

Although testing apparatus, such as dynamometers, speed-indicating instruments, etc., have been greatly improved since the tests of Mr. Lewis, satisfactory results are even now only obtained with an expenditure of considerable time and patience. Since authentic data on the efficiency of modern gearing are scarce, any reliable information bearing on this subject is welcome. I therefore take this occasion to publish the results of tests that I have made at different times on spur, bevel, worm and crown gears, and trust they may be of interest to readers of the AMERICAN MACHINIST.

The recent rapid refinement of motor-car details has given a great impetus to the investigation of the adaptability of the various forms of gearing to the transmitting mechanism. Efficiency and unit strength have been the chief considerations, and it is of the former that this article will treat. In making the tests, average running conditions have been imitated as closely as possible.

### TEST METHODS

The various tests ranged through a period of nearly two years and two different sets of apparatus were used. Spur, bevel and worm gears were tested without any special transmission dynamometer, but merely utilized a standard direct-current motor, especially equipped and calibrated for this purpose, Fig. 1. The standard motor would not have required any special equipment were it not for the fact that the 30-horsepower size used, ran at too low a maximum speed to give a sufficiently high speed range. An adjustable-gear set was therefore designed to slip on the pulley end of the armature shaft, with the gears boxed in and running in oil. In this way, gearing under test could be run at any desired speed, although a separate calibration curve for the motor and attached-gear set was necessary for each speed. The motor shaft and the jack shaft, to which the two gears were keyed in annular ball-bearings, were held rigidly in the same relative position by the two steel side plates $A_1$ and $A_2$. The jack shaft $S$ could be located at any point in the circumference of its travel around the motor shaft as a center, to accommodate the testing set, and was rigidly clamped to the frame of the motor or floor. The end of the jack shaft $S$ was equipped with a Prony brakewheel $W$ to facilitate the calibration of the motor.

The electrical end of the motor was so connected to a testing table that an ammeter and water rheostat were placed in the armature circuit, an ammeter and field rheostat in the field circuit, and a voltmeter to indicate the voltage applied. An accurate speed-indicating instrument was placed on a standard where it was easily attached or detached from the commutator end of the motor shaft, and the regulator for the water rheostat was near enough to allow the person operating it to observe and regulate the speed readings.

To calibrate the motor, the Prony brake and its accessories were adjusted for a certain load, the field rheostat for a current, and the water rheostat for a certain speed, as previously determined. The armature current and voltage were then noted as giving the power input, and plotted against brake horsepower delivered for the calibration curve under those conditions. The motor should be operated for a short time on about half load to make the losses constant, and frequent checking should also be done to make certain that the armature resistance losses have not materially changed. Any change would be indicated by a change in voltage relative to speed for the same ammeter readings. Familiarity with all parts of this equipment is necessary before accuracy can be expected.

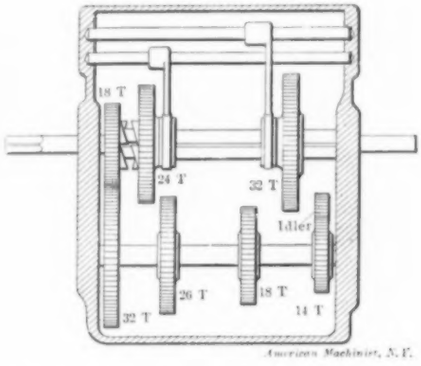



FIG. 2. DIAGRAM OF TRANSMISSIONS USED IN TESTING SPUR GEARS

### SPUR GEARS

Although the tests made on spur gearing were made for the purpose of deter-

mining the efficiency of a standard slide-gear transmission, Fig. 2, at the different gear ratios, the mechanical losses given are almost entirely distributed between the two pairs of gears, since all of the bearings are of the ball type. The gears are six pitch, 1-inch face and the number of teeth of each gear is given in Fig. 2. The material of the gears was a nickel-alloy steel, heat treated; and this combined with a generated-tooth form gives a hard, smooth tooth surface. Figs. 3, 4 and 5 are curves giving the efficiency of the combination at variable speed, each curve representing a constant power delivered to the transmission.

### Bevel Gears

Bevel gear efficiencies were determined by the test of a rear motor-car axle, all bearings being of the annular or thrust-ball type. As the friction losses of these bearings are very low as compared with that of the gears, for all practical purposes they need not be considered. The teeth were 14½ degrees involute, ½-inch pitch and 1½-inch face. The pinion had 15 teeth and the driven gear 53 teeth, and during the test they were immersed in a heavy oil. Previous to the test the gear teeth were hardened and ground. Fig. 6 gives results of the test for four different loads, each one constant for a variable speed.

### Worm Gears

A pair of worm gears were tested in an axle in a similar manner to the bevel gears, and the results are given in Fig. 7. The worm was of steel five-threaded and having a lead of 4.6 inches. The gear was of phosphor bronze, 11.1 inches in diameter and had 38 teeth. The thrust bearings were of ample proportion, but in spite of this became quite hot, as most of the 11 per cent., or more, of the power lost is due to the thrust of the worm. Although the efficiency of a worm gear will vary widely with different pitches, diameters, leads, materials, etc., the curves in Fig. 7 will represent average conditions.

### Crown Gears

The crown or face gears antedate the bevel gear, but the limited use and inefficiency of its simple form, as then known, caused it to be supplanted in most mechanisms by the more efficient and stronger bevel gear. In recent years the search for simplicity in automobile construction has led to many designs for combining the multiplied transmission gear and the rear-axle bevel-drive gear into one unit. Very few of these designs made use of the crown gear owing to obvious difficulties.

Karl Probst, mechanical engineer for the Seagrave Company, of Columbus, O., has perfected a gear combination which is merely a spur-gear pinion meshing with a

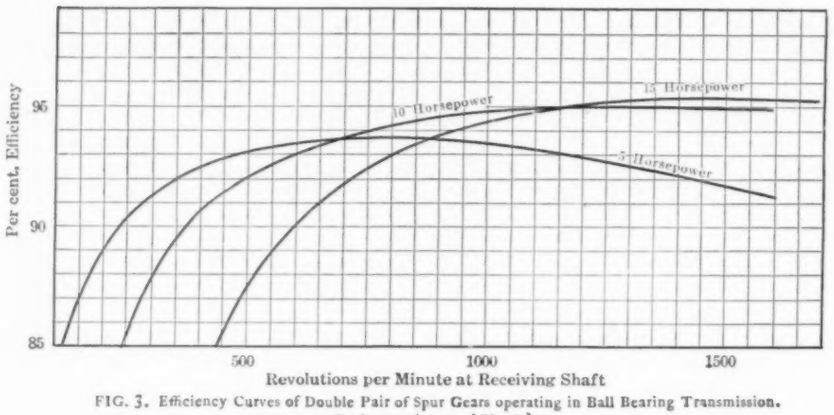



FIG. 3. Efficiency Curves of Double Pair of Spur Gears operating in Ball Bearing Transmission. Ratio = 1.76 to 1. (Fig. 2)

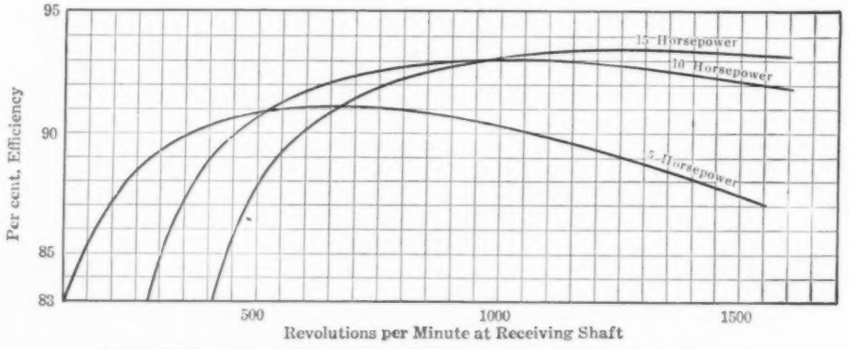



FIG. 4. Efficiency Curves of Double Pair of Spur Gears operating in Ball Bearing Transmission. Ratio = 3.36 to 1. (Fig. 2)

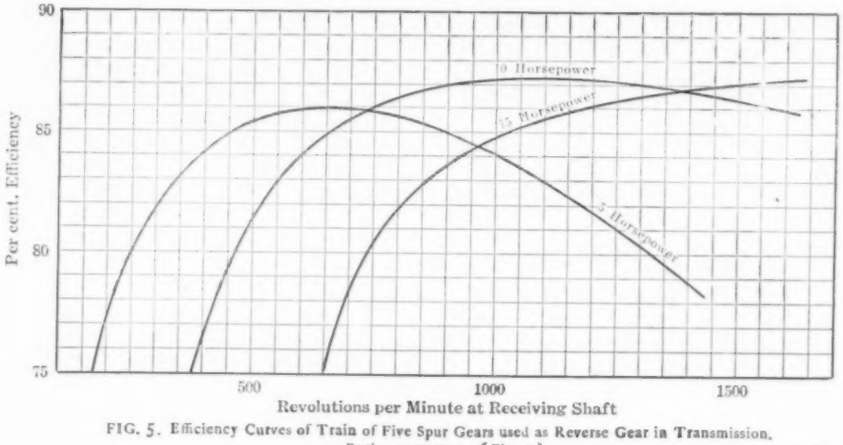



FIG. 5. Efficiency Curves of Train of Five Spur Gears used as Reverse Gear in Transmission. Ratio = 4.32 to 1. (Fig. 2) *American Machinist, N.Y.*

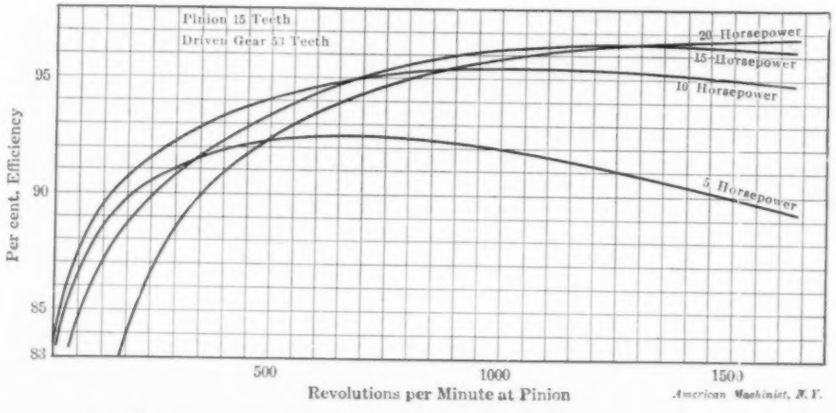



FIG. 6. EFFICIENCY CURVE OF BEVEL GEARS IN AUTOMOBILE AXLE

gear whose teeth are in a plane at right angles to its axis and so cut on a Fellows gear shaper as to give line contact, thereable. A transmission dynamometer utilizing a calibration spring measured the power delivered to the axle and a Prony-

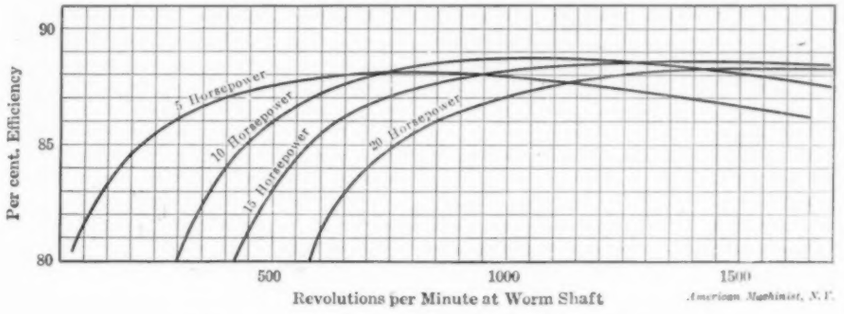



FIG. 7. EFFICIENCY CURVES OF WORM GEAR AXLE

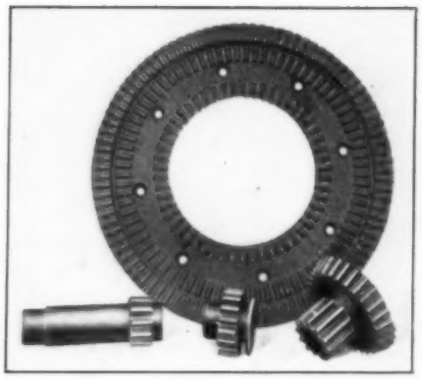


FIG. 8. CROWN GEAR AND PINION USED IN PROBST AUTOMOBILE TRANSMISSION

by greatly increasing the strength and efficiency of the combination, and consequently its adaptability. Fig. 8 is a photograph of the gears used in a 15-horsepower axle. Three concentric gears are cut on the same blank, and the two inside ones are in the same plane and mesh with the same spur pinion, which is shifted from one to the other in changing between intermediate and high gear. The outside gear is the low gear ratio and when in mesh with the back gear *A* gives the reverse. Fig. 9 shows a later form of this gear assembled in an axle. The outer gear of the concentric set has been shifted to the back of the gear plate and is driven from the spur pinion through one back gear for the low-speed forward and through two back gears for the reverse, as can be traced out in the cut. All bearings are of the annular-ball type thus making the bearing losses practically negligible and permitting a just comparison of efficiency with other types of gears. Fig. 10 shows the crown gear adapted to the motor cycle.

The efficiencies of the crown gear at different ratios, speeds and loads were obtained by using somewhat different equipment than was used in previous tests as the former apparatus was not available. A transmission dynamometer utilizing a calibration spring measured the power delivered to the axle and a Prony-brake wheel and arm similar to that shown in Fig. 1 measured the power delivered to the wheels. Fig. 11 is a photograph of dynamometer, axle and brake arranged for test. Previous to the test, the springs were calibrated in a stationary position by reading the torsion on a graduated ring due to a certain torque in foot-pounds, applied by especially attached and weighted levers, one on each shaft. A curve of calibration is thus obtained and then when the apparatus is running the torsion multiplied by the speed gives the power transmitted. Each end of the spring carries a ring having a thin insulated-copper bar in its periphery. Bearing on each ring is a single-leaf copper brush, and when both are adjusted in synchronism or in

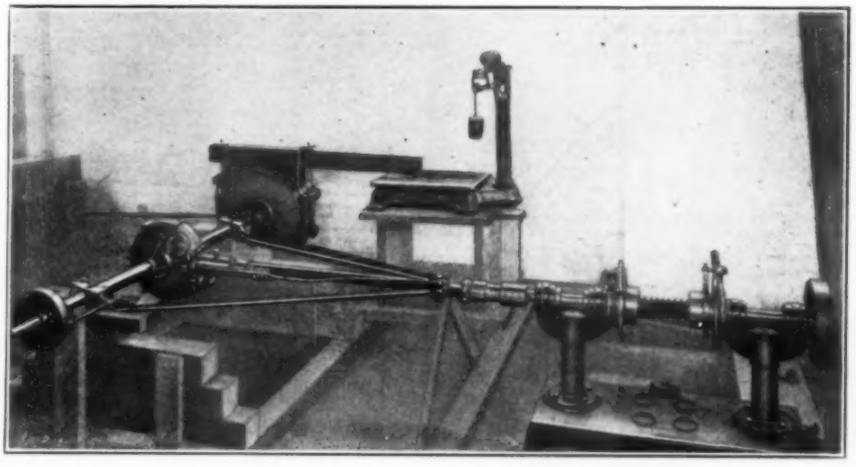


FIG. 11. TESTING APPARATUS USED IN TESTING CROWN GEARS

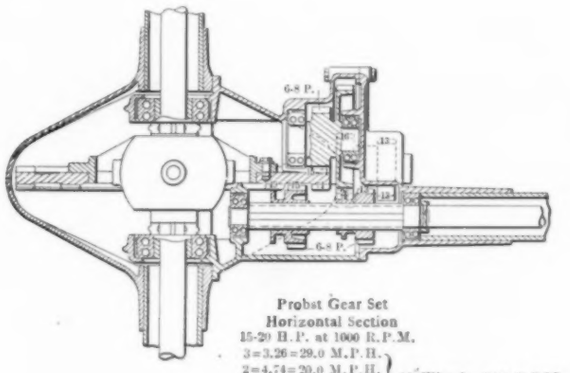



FIG. 9

PROBST GEAR APPLIED TO AUTOMOBILE

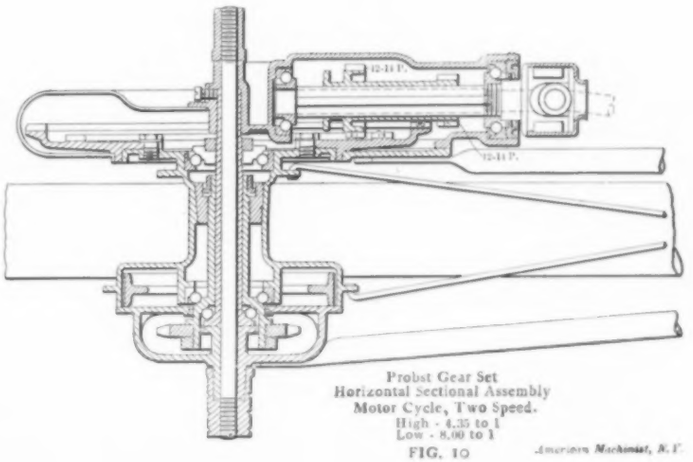



FIG. 10

PROBST GEAR APPLIED TO MOTOR CYCLE

contact with its bar at the same instant during each revolution, an electric circuit is completed through a telephone receiver. By first obtaining the zero correction, and then, when running, rotating on one brush about the graduated ring until the telephone receiver indicates synchronism, the reading will give the deflection of the spring. Reference to the calibration curve will give the power transmitted. Careful checking of the complete apparatus was necessary before great accuracy was assured.

Figs. 12, 13 and 14 give the efficiencies at the different ratios as indicated. Each power curve refers to the horsepower delivered to the Prony brake or what would be the wheels of the motor-car in service. In comparing the efficiency of the crown-gear transmission and bevel-gear axle, it is at once evident that for low and medium power, the former shows up remarkably well. Although somewhat less efficient than the bevel gear alone, the crown gear gives better results than the other two together, at low powers, or what would be average running conditions. As the load increases and the speed decreases the efficiency of this gear decreases much more rapidly than with other gears. Nevertheless, on account of its simplicity, compactness and efficiency, the crown gear will without doubt be used extensively in low-powered runabouts.

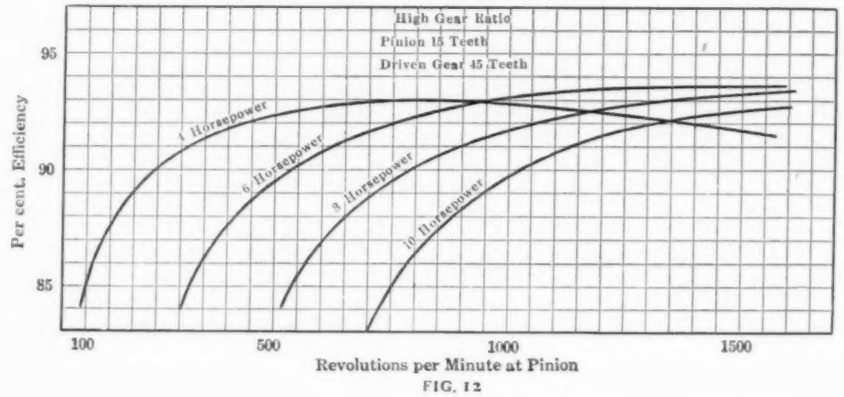


FIG. 12

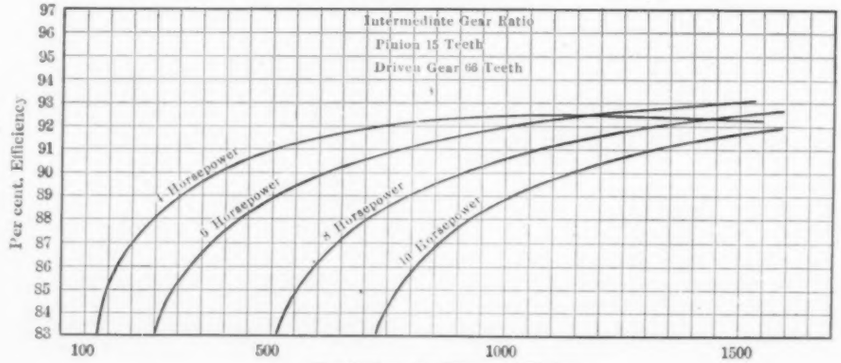


FIG. 13

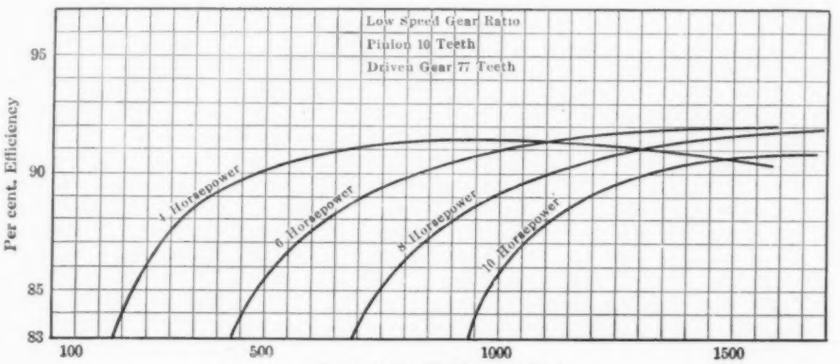


FIG. 14 *American Machinist, N.Y.*

EFFICIENCY CURVES FOR CROWN GEARS IN PROBST TRANSMISSION

## Duplicating a Planer Bed

To the average mechanic, duplicate work recalls or brings to mind some sort of a turret or automatic screw machine, and many of us do not realize the extent to which the duplication of machine tools themselves has been developed, particularly in the building of planers. We are accustomed to think of planer beds and tables as being planed and scraped to each other, and the suggestion that it is possible to duplicate such parts without even seeing the piece which is to run with it would be sure to arouse serious misgivings on the part of many good mechanics.

An extremely interesting case of duplication of a most unusual kind has recently come to notice in the case of a planer bed being broken through the failure of a crane chain in moving it from one location to another. The bed of a 62-inch Cincinnati planer used in the Meadows shops of the Pennsylvania railroad was broken in this way, and they immediately wrote the Cincinnati Planer Company to know what could be done about replacing it.

To their surprise the reply was that a new bed would be made and shipped according to their standard, and this has recently been done, the new bed being such a duplicate of the one which was broken that the various parts went into place without difficulty. This means that the new bed had to, not only fit the old table, but to receive all the old driving mechanism in its correct position so that the bull gear would mesh perfectly with the table rack, that the housings would match the bed in every particular, even to dowel and bolt holes, all of which speaks volumes for the accuracy of the fixtures used by the builders, and also the care with which they are used in the shops.

We have never known of a case where a large machine tool was duplicated in just such a way as this, although possibly similar cases may have occurred before; but it is a very gratifying indication of the progress which has been made in commercial shop methods used in the production of machine tools.

The master mechanic of the Trenton shops of the Pennsylvania railroad, where the rejuvenated planer is now at work, informs us that the time taken to erect the planer was no more than as though it had been a complete new machine, which indicates that practically no fitting had to be done.

---

What is claimed to be the deepest diamond-drill hole in the United States was recently completed on the Marquette iron range in Michigan. It is 3265 ft. deep.

# Planing in a Machine Tool Shop

EDITORIAL CORRESPONDENCE

In a previous article on lathe building and testing operations at the shops of the Hendey Machine Company, Torrington, Conn., reference was made to the work of its planer department, some additional views of which are presented herewith. As in the case of the lathe beds referred to in that article as planed up six or eight at a setting, saddles, headstocks, tailstocks, and various other parts are handled a large number at a time on the planer. Thus, in Fig. 1 two 4-head planers are shown machining the tops of lathe saddles, one of these machines being a Gray 36x36 planer, the other a Chandler 24x24-inch machine, both of which have platens 24 feet in length, so that a long string of work may be handled at one setting.

The Chandler planer shown has a return speed of 200 feet per minute, both machines illustrated being belted to cut at 50 feet per minute, with high-speed cutting tools. This cutting rate of 50 feet has been found at the Hendey shops to be generally satisfactory and is used on practically all of the planers operating on this class of work.

Another planing operation on lathe parts is represented in Fig. 2 where a long

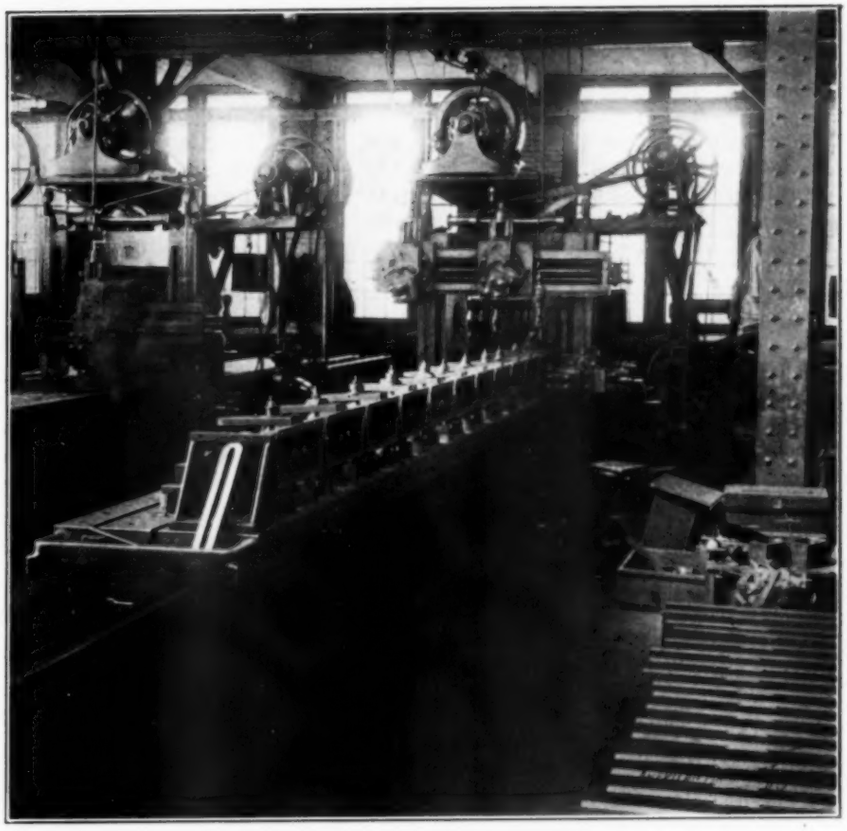


FIG. 2. PLANING LATHE HEADSTOCKS

FIG. 1. PLANING LATHE SADDLES

row of headstocks is shown strapped on their sides on simple fixtures on the platen while the flat and V-surfaces along their bottoms are planed with the side head.

Fig. 3 is a view of the largest planer in the department, a Gray 60x60-inch with 30-foot table. When this photograph was taken the machine was in operation on a large group of castings consisting of 22 headstocks and 22 tailstocks for Lincoln millers; the greater part of these will be seen in the view. The cuts taken at this setting are down the sides of the uprights between which the spindle boxes and arbor supports are later mounted. The four planer heads are used simultaneously here, the two main heads carrying long heavy tool bars in the ends of which the cutting tools are secured. Two cuts are generally taken over these surfaces. When planing down the slots between uprights to receive the spindle boxes and outer support for the cutter arbor, these two tool bars are fitted with double-end planer tools which are made up in pairs for roughing and finishing. The roughing tools are made about 1/16 inch short, thus leaving about 1/32 inch on a side for removing in the next cut by the finishing tools, which are made exactly to length.

As shown in the different views, each of the planers is independently driven by electric motor mounted on the top of the housings.

## Belt Drives vs. Positive Drives

By Con Wise

"Belt drives versus positive drives" is a topic that will bear a good deal of attention. When we look back through all the means of creating motion we find everything beginning with a non-positive drive. Our steam engines are propelled by an elastic medium. Our water wheels so balance load against speed that they are most troublesome to govern; the gas engine is worse. The next step, to get the power to the line shaft, was once considered a problem in gearing; today the cases are few and far between where gears are considered for this purpose. Transmission from prime mover to line shaft or tool by electricity can hardly be considered positive. When we reach the line shaft, belt connection to the machine to be driven is a necessity, unless the line shaft has been superseded by electric drive. Up to this point we are so accustomed to belt drives that we simply give the belt width enough and speed enough to carry the load, and never question but what we can fit the belt to the case.

Now when we come to the next stage, transmitting power to different parts of the machine, there are various places where it is necessary to maintain positive relations between the speed of the driving and driven shafts, which can alone be accomplished by means of gears. Such a case is the driving of the lead screw of a lathe, or the spiral head and feed screw on a milling machine. On the other hand the exact relation between speed and feed on most machine tools is not essential. It is no more necessary that the feed rod of a lathe should make any exact number of turns per minute, than it is that the spindle should make an exact number.

When power feed was first applied to lathes the power necessary to drive the cut was very little and the power for the feed inappreciable. Some of these old lathes had a quarter-inch round belt to drive the feed. One that we used in the first shop I was acquainted with had this size of feed belt but it ran on good-sized pulleys, and drove a worm and gear in a ratio of about 200 to 1. The worm gear carried a chain wheel which pulled the carriage along. Of course, the feed was fine but there was ample power. As lathes were designed for higher duty the cone belts and back gears were increased, but practically no attention was paid to the feed belt; so we have today advertised in the columns of the American Machinist lathe after lathe with little narrow feed belts: 1 inch wide for 18 inches, 1¼ inches for 24 inches, just about as they were made by Wood and Light and the New York Steam Engine Company at the time of the war.

Or worse yet, I have a photograph of an old wooden-bed lathe, with wooden cone, which was certainly as old as the time of the war of 1812, and had a feed belt an inch wide. The lathe was originally 20 inches swing, raised in the solid to 24 inches and with raising blocks to 30 inches. In no other machine tool, with the possible exception of the milling machine, have we been so slow to advance in this direction.

All the trouble with feed belts is, that they have never been designed at all. Let any designer find out how great is the pull at the surface of the feed pulley to carry a given cut and feed and he would design a belt about three times as wide and running about four times as fast as is to be found on the average lathe. But instead of using a better designed belt he puts on a gear of the same width and cut, say, 10 pitch. His one-inch belt will safely carry 45 pounds pull with 25 pounds on the slack side, a net pull of 20 pounds. His gear, if of cast iron, will carry over 100 pounds easily. It will take 200 pounds to break a tooth. Yet teeth break out occasionally. Now if our designer had made a belt drive either by speeding up the belt, or by widening it, or both, he could have brought his belt up to carry whatever net pull he liked and yet have had a surety of slipping before something broke. A belt is the only safety device for the purpose that is ready to start up again and run as soon as the overload is taken off.

The expense for gears enough to give these speeds of feed is greater than the expense of gearing up the feed cone pulley on the head of the ordinary lathe so as to get a faster running belt. The change in the design of the lathe apron to allow for a faster running feed rod might cost quite a little, and it might not cost anything, but it could not cost enough but that it would pay to do it rather than put on a geared feed.

FIG. 3. PLANING HEADS AND FOOT BLOCKS FOR LINCOLN MILLERS

# Principles in Design of Friction Clutches

## Emphasis Is Laid on a Proper Time Interval for Engaging a Clutch and a Construction Suggested Embodying This Feature

BY J. RICHARDS

In a late letter from an eminent designing engineer in England, there is the following remark: "I do not like friction clutches and never, under any circumstances, embody them in a design, when their functions can be attained by other means." This I conceive to be a common opinion among engineers and mechanics, and considering the many very useful functions performed by these clutches, it is certainly time to proceed to some analysis of the matter, to find out wherein the faults lie.

Beginning generically, so to speak, their purpose is to transmit power and motion by tractile force or friction, as has been done for centuries by bands in a very satisfactory manner, the conditions of operating being much the same, or nearly the same—the main distinction being that in stopping and starting the cumulative tractile force is in the case of bands attained by the extent of "area" in contact and in the case of clutches by the amount of pressure between the tractile surfaces. This proposition, being one of fact, needs no discussion; but out of this fact comes a corollary of much significance—the key, in fact, to the impediments and bad reputation of friction clutches.

In these, of whatever kind, the engagement and the tractile force exerted are both functions of pressure; so, also, is their endurance; but this latter will be considered further on.

### Pressure and Endurance

Pressure on the surfaces is also a commercial "exponent" of friction clutches. Their dimensions and cost to construct are inversely as the pressure to be endured, and in this fact lies the incentive to high and destructive pressures. A small clutch —one of 18 inches diameter, for example —capable of transmitting 50 horsepower, is apt to be regarded as a wonderfully efficient implement and so it is; but it carries on its face the mark of its own destruction. It cannot endure.

Generalizing further, we find that throughout the whole field of machine bearings pressure is a coefficient, so to speak, of endurance and good performance. Exceptions may be pointed out, in the case of slow movement, but the rule holds good and has full recognition in the modern method of increasing the surfaces of bearings; which is the same, in effect, as reducing the unit of pressure.

Reverting again to the example named, suppose that the 50 horsepower is to be transmitted to a shaft revolving at a rate of 200 revolutions per minute, and the friction clutch is to be substituted by a band. This latter would, for example, be 10 inches wide, on a pulley 36 inches diameter, and the frictional-contact surface be not less than 500 inches of area, moving about 1900 feet per minute. In the case of the friction clutch, the area of frictional contact would be, perhaps, an eighth as much and the velocity half as much; so the comparison of contact would be as 16 to 1 and the pressure to produce a given tractile effort would be in the same proportion. If the pressure on the band was 2 pounds per inch, that on the clutch would be 32 pounds per inch.

These quantities are roughly assumed; but, as a matter of fact, will, I think, come within the field of common practice. One of the conditions is destructive, the other is enduring; but this is not all.

Suppose the two means, a band and a clutch, are to perform the same work and

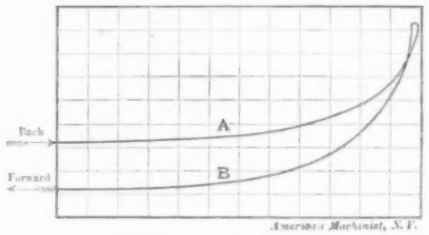



FIG. 1. SUGGESTIVE DIAGRAM OF MOMENTUM OF A RECIPROCATING TABLE AND FORCE OF A CONTROLLING FRICTION CLUTCH

to be frequently stopped and started, the band to be shifted to a loose pulley for this purpose. Here will arise a further distinction—one of importance—that has to do with both performance and endurance; that is the time or rate of engagement, or, in other terms, the control of pressure. In the case of the band, it *must* be shifted by degrees and by deflection edgewise to wind spirally upon the pulley to be driven, the increment of area and consequent slipping, which is an essential feature, has to be cumulative and gradual, avoiding overstrain and pressure. It is true a clutch can be engaged in the same manner; but it need not be—is not in any but exceptional cases.

### Other Difficulties to be Overcome

In the two features pointed out, we can see the causes that have earned friction clutches their bad reputation. There are other impediments, such as centrifugal force, frequent and unequal adjustment, with more that could be named; but the intensity of pressure and its irregular application account for a want of endurance, the chief fault of friction clutches.

This compendious "screed" is merely suggestive. A complete analysis that embraced all the elements that enter into friction clutches would call for graphic illustration and consume more space than is at present at my disposal; but the "game is worth the candle," if it will contribute to a new and improved form of these implements, so widely demanded in modern constructive arts.

### Position of Friction Surfaces

In the preceding paragraphs the premises assumed related to two features—an admissible unit of pressure and the limit and time or rate of applying this pressure—but there are other conditions of operating to be considered, before proceeding to constructive design.

One of these is the position of the friction surfaces. These, in practice, can vary from radial or normal to the shaft to parallel therewith and do so vary in practice. In the case of radial faces, the pressure to engage a clutch must equal that on the frictional faces and this introduces what are commonly perishable devices; besides, the wear at any point of the faces is as the speed at that point and is unequal, tending to a curve of "equal tangents," as it is called.

Such clutches are employed only for light purposes, because of the reactive strain on setting gearing, so that some angle is chosen, not only to reduce reactive strain, but to secure concentric wear and more uniformity of surface speed.

In clutches with their frictional surfaces parallel to a shaft and excluding embracing straps or brakes, the usual construction is an expanding interior member with great pressure and "toggle abutment" against the center or nave, also, sometimes, by coiling springs and in other ways, but always with interior pressure and commonly metallic-friction faces.

These features may not, at first, seem directly relevant to the present subject, but are so, nevertheless, if we are to reach a logical conclusion, and circumstances point to frictional faces oblique to the axis of revolution and of such inclination as will permit instant and automatic release, preserve concentricity and at the same time increase the unit of pressure by the wedging action. Such angle for these faces should be 20 to 30 degrees from the axis.

### Setting or Engaging Mechanism

The next feature to be noticed is what we may call setting or engaging mechanism. This must, in all cases, overcome a considerable resistance and in most cases sustained resistance through collars or what may be called running joints or bearings, that are apt to lack endurance and involve a considerable mechanism.

Taking into account the many and varied devices employed in setting, we find that velocity and consequent wear is generally their fault and while the strains or pressure cannot be avoided, we can reduce velocity by connecting through the axes of the shafts on which the clutches are mounted.

This latter seems to be the best manner of operating friction clutches, proved by its use in marine and other winches, also in winding and hoisting machinery. Reasoning inferentially, there can be no doubt of the advantages possessed by this method of operating through the axes of clutches. The details are reduced, the "pull" can be compensated and the velocity slow enough to maintain collars on the setting rods.

These remarks apply to any case where the ends of shafts are available, which, by proper design, can be almost anywhere. The subject is much wider in importance than would be imagined. It brings to mind an incident of twenty or more years ago, when a shrewd lathe man was observed stuffing his cap with waste, and in reply to a question about headache, said: "No, it is those infernal friction clutches on the countershaft. A piece comes down here, every little while, usually on the top of my head."

In all these contrivances for setting clutches, such as cones, wedges, toggles, *et al.*, there are always pieces to "come down," come out or come loose, and practice, especially in hoisting and lowering gearing, tends to the center rod and a through cotter connecting to the movable-clutch member.

Previous to any remarks here upon constructive features, it is thought best to go over all the general premises and operating conditions. This is not an easy way for either the reader or for me, but it is the best way to get at the subject understandingly.

### The Engaging of Clutches

The next element or feature to be considered is the setting or engagement of friction clutches—the most interesting part of the problem and from which may come copious suggestion for construction.

In most cases, the work of the clutches, or the resistance it may be called, is regular or at least uniform and determinable, quantities that can be computed and demonstrated with their limit and degree. Opposed to this is the tractile force of the clutch; but the adjectives above do not apply to this, or at least are not applied to the setting or engagement of the clutches. This in many cases is performed by hand and without any rule whatever or any care.

There are, however, such a wide range of uses and adaptations, that it will be necessary to assume a concrete example, such as the stopping and reversal of reciprocating machines—a metal-planing machine, for example, which at this time is the subject of extensive experiment among the makers of machine tools in this and other countries. It is in extended use and affects directly the cutting or effective time of working with such a machine. Obviously the manner of proceeding should be by constructing a diagram as in Fig. 1, representing the two opposing forces, *A* the line of momentum for the mass or table of the machine and its load, and *B* the line of resistance by a friction clutch to overcome the momentum, stop and reverse the motion. All the quantities seem computable in a particular case; but this is not necessary here, so the diagram is of use only to illustrate what is meant and omits lines for inertia and reversing frictional resistance of the ways and so on.

From the features already discussed, the reader will be in the way of plotting to some extent the line *B* after *A* is assumed and is on the road of a logical solution and key to a suitable construction.

The line *A*, as remarked, is a definite and computable one, from assumed or known quantities, and obviously the line *B* must be the opposite in degree or force, but must contain certain conditions or factors, as follows: (1) maximum resistance required; (2) a limitation of force to guard against overstrain and accident; (3) a cumulative rate of resistance, with increment as indicated by the curves; (4) how much the line *B* can be modified to save time without imparting shock or damage to the gearing and parts.

The last named factor is one of experiment and introduces another of a constructive nature, namely: adjustable means to change and regulate the resisting force in the line *B*. This has to be varied to suit different speeds, now commonly provided for in metal-planing machines and requires setting by sound and sight, thus constituting a peculiar use, but an extensive one, that embraces all difficult conditions and is selected for this reason.

It so happens, however, that the functions all lie within fairly cheap and durable mechanism, as will now be shown by the drawing, Fig. 2.

### A Suggested Construction

The diagram, Fig. 2, is prepared to show how the preceding feature may be carried into operative effect. It is not intended for more and admits of a wide range of constructive design. Following out these several features, there is, first: the area of contact at *C*; taking into account the space and speed of right and left belts on *A* and *B*, the arcs of contact are about equal and the tractile force of the clutch and belts is about the same, not taking into account the reduced contact of the bands by reason of centrifugal force.

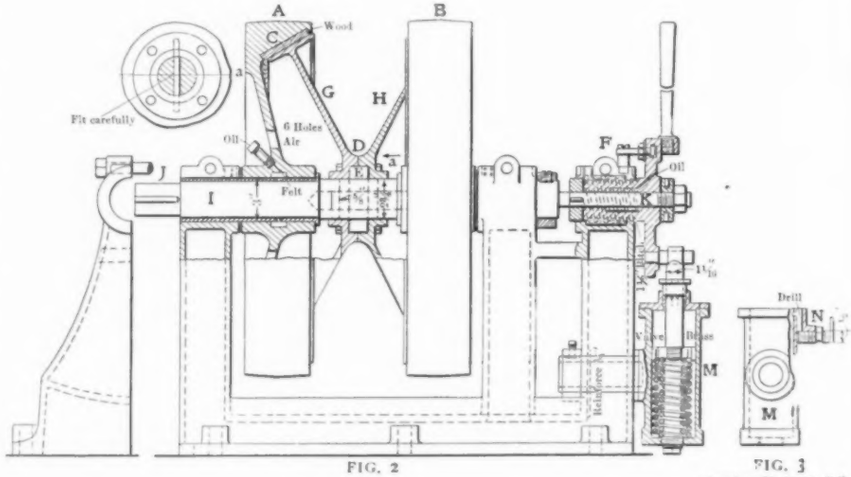



FIG. 2 FIG. 3

American Machinist, N.Y.

SUGGESTED CONSTRUCTION OF A FRICTION CLUTCH ENGAGING IN A PREDETERMINED AND CONTROLLED INTERVAL OF TIME

The pulleys or flywheels *A* and *B* form one member of each clutch and with the inner members *G* and *H* have webs of angular section to increase stiffness, also to permit housing and protecting the parts. The parts *G* and *H* are practically but one, but are in two parts to house the cotter *E*, which slides on and drives the shaft *I*, which connects at *J* to the machine to be operated.

The clutch movement, which can be from ¼ inch to ½ inch, is by means of the central rod *K* moved by an oscillating screw-nut that has a motion each way by hand or tappets and is forced right or left by a strong spring and piston *M* that has a cumulative force each way, but regulation as to time and also as to range. The time factor is by means

of a liquid in the cylinder *M* that must flow from the top to the bottom as the piston rises and as the clutches engage, the time being regulated by a screw valve *N* seen in Fig. 3. The liquid is free to flow upward by a free-ring valve in the piston, as seen. Thus is provided an adjustable controlling force that is purely automatic.

The range of this engaging motion or the extent of pressure that can be applied on the clutches is determined each way by stops at *F*, which can be set accordingly. Thus the time or rate of closing the clutches is fixed and must by either hand or power occupy a certain space of time, otherwise they are liable to be jammed into action and injured. The distinguishing feature is that the clutches engage in predetermined time and in this respect differ from all methods hitherto attempted, so far as I am aware.

The angle for the frictional face, disposition and kind of tractile material, method of framing and indeed all the parts are the subject of varied constructive design, so long as the principle or mode of operating is kept in view, remembering the subject is "friction clutches to operate reciprocating machines."

It is suggested that reversing friction clutches should, like machine chucks, become an organized manufacture. No one wants to make such a device for a special use when the adaptation would be complete and the cost be half as much by an organized manufacture.

In preparing the example shown, there was in mind belts five inches wide moving two to four thousand feet per minute, but in use the same machine could answer for two to ten horsepower, a circumstance that especially favors organized manufacture.

## Collapsible Pattern and Molding Machine for Cone Pulleys

By C. Nosrac

A short time ago a small iron foundry in northern Illinois started in to make a specialty of cone pulleys, and for this purpose they have developed a molding machine that will turn out a flask every three minutes. The pulleys made from these flasks have no broken edges and no taper to the cone steps, as the pattern is made without draft owing to its peculiar action in the sand.

The machines that were in operation at the time of my visit were of a very crude construction and could be much improved from a standpoint of mechanical design, yet they worked daily without any trouble whatever.

The accompanying sketches will show the principles of the machine and its collapsible pattern. Fig. 1 is a sectional view of the pattern, which consists of the several sections forming the steps of the cone pulley, the stop rings, and the screw and handwheel for collapsing the pattern. The screw swivels in the first cone step, and the end is protected by the shell which forms the smaller coreprint. Each cone section telescopes up into the next larger one. The pattern, after being collapsed, presents the appearance shown at *S* in Fig. 3.

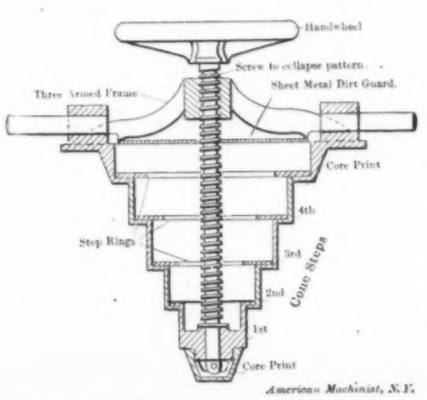



FIG. 1. COLLAPSIBLE CONE PULLEY PATTERN

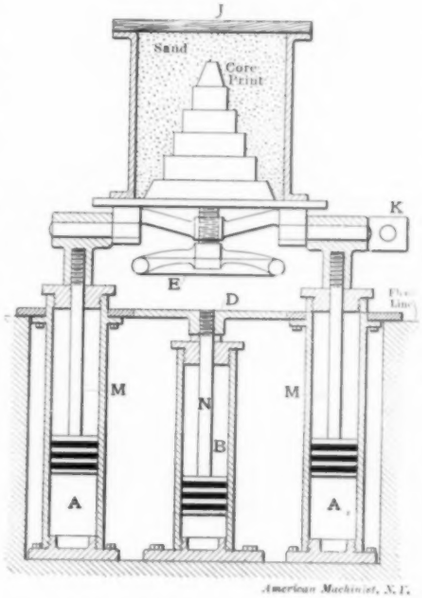



FIG. 2. MOLDING MACHINE WITH PULLEY RAMMED UP

This pattern is mounted in the molding machine on two trunnion bearings that are attached to the upper extremities of the piston rods *M M*, shown in Fig. 2. It is rotated by means of the long lever *K*. The pistons operate in the air cylinders *A A*, and these are connected with the compressed-air supply. The cylinder *B* is also similarly connected through a second lever valve, and its piston *N* carries a circular table *D*.

The operation of the machine is as follows: The pattern is extended, inverted, as in Fig. 2, and is locked by means of the lever *K*. The flask shell is then placed

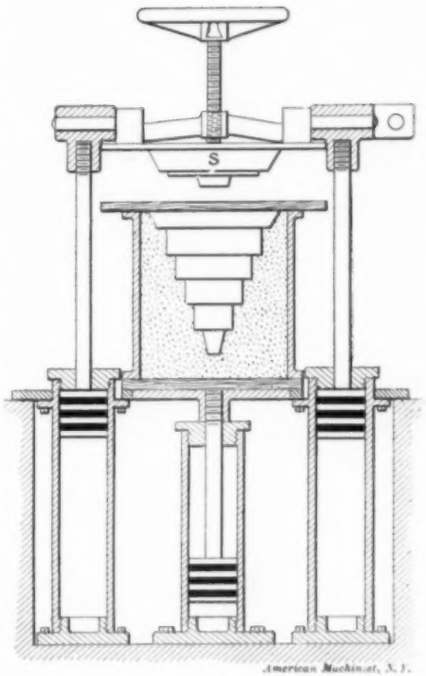



FIG. 3. MOLDING MACHINE WITH PATTERN DRAWN

in position and secured by bolts that swing between ears cast on its flanges. Air is then turned into the two cylinders *A A*, causing the flask and pattern to rise. The mold is rammed from above, after which the board *J* is placed over the flask and secured by swing bolts in the same manner that the flask is held to the pattern frame. The lever *K* is then released and the flask is swung down into a pendant position.

The handwheel is now operated, and this draws the pattern step by step. The first cone step is pulled up into the second without disturbing the others, owing to its smaller surface friction. The sand is well supported all around the top, during the drawing, by the cone above.

The first step when way up strikes the stop ring, and thereupon picks up the second step and so on until the pattern is wholly collapsed. Air is then admitted to cylinder *B*, causing the table *D* to rise and support the flask.

The flask is then unlocked from the pattern and the air released from cylinder *B*, whereupon the table descends with the flask, leaving the pattern in the position shown at *S*, in Fig. 3. The flask is then lifted from the machine and set aside to receive its core. After this the pattern is extended and inverted again; the air is released from cylinders *A A*, allowing it to descend, and a new flask is placed in position ready for the second mold.

The cores are molded with a different pattern on this same machine, and after being baked are laid aside for future use. The pulley is poured through the core itself, and the resulting castings are superior to anything yet seen along this line.

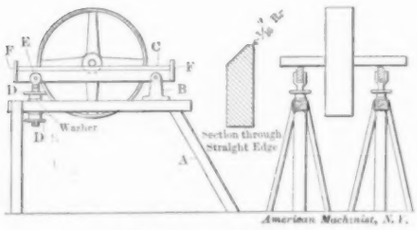
## A Balancing Device

By Anthony

The device shown in the accompanying sketch, while not elaborate, has proven by constant use to be efficient.

The frame *A* is a three-legged wooden horse, the three legs giving a three-point bearing. On the frame *A* is a wooden basket *B* which is slotted at the top to admit the straight-edge *C*, a pin holding the straight-edge in place and allowing it to swivel when being adjusted by the small handwheel *D*. The screw *E* is a forging and is also slotted at the top to admit the straight-edge *C* at the other end, where it is held in place by a pin as at the other end in the bracket *B*.

The end pieces *F* on the straight-edge *C* are to prevent whatever is on the straight-edge from rolling off. Referring to the sketch where the section is shown, it will be noticed that instead of a narrow flat edge at the top, the edge is rounding. The reason for this is that this device is used in different places in the factory and the floor is uneven. If the straight-edge is canted to one side and if the edge is flat, the arbor will be running on a sharp corner. The edge being round overcomes this, and prevents the arbor from being cut into should the object being balanced be very heavy.



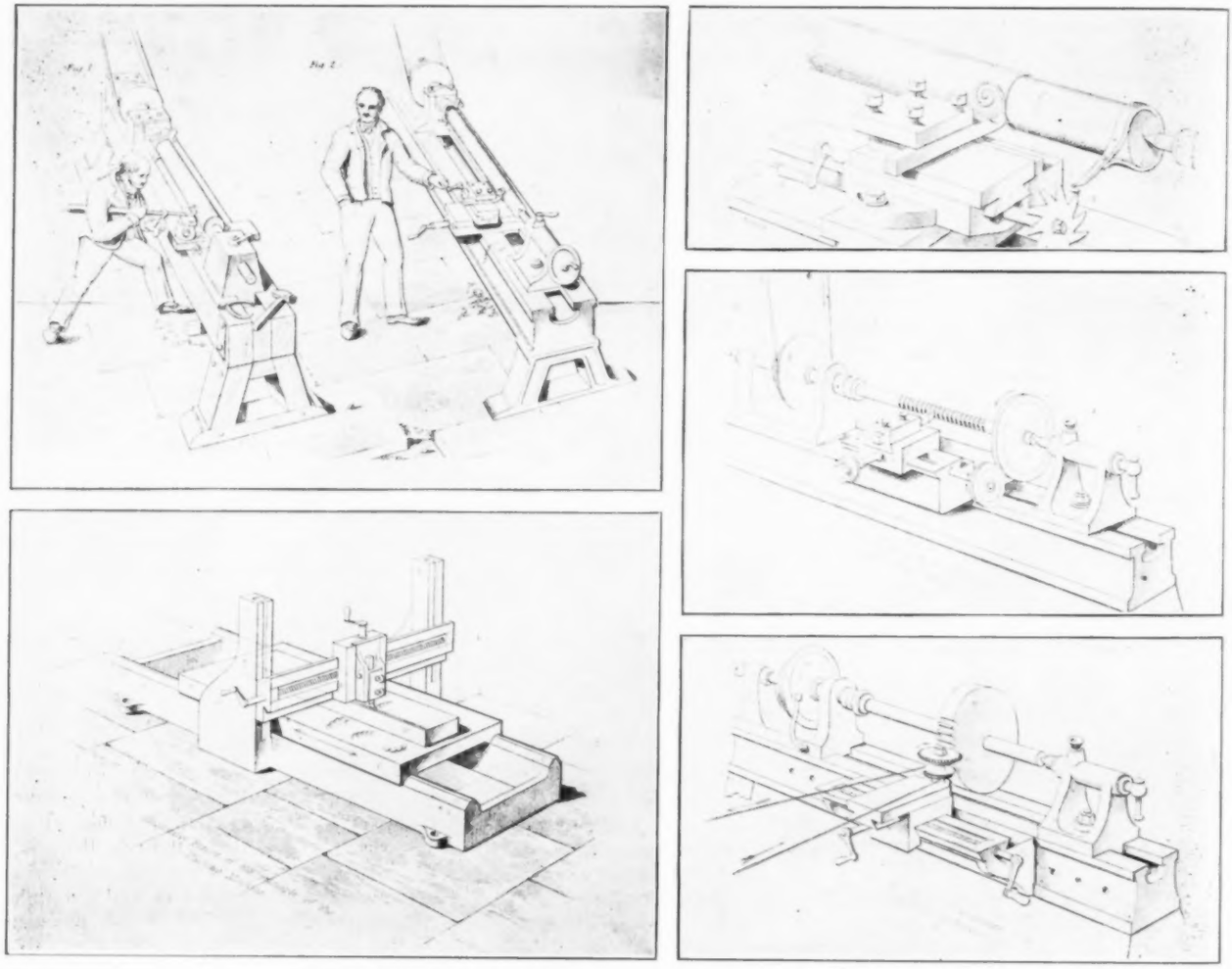

A BALANCING DEVICE

## Illustrations of Progress in Machine Tools

By A. Turner

I have followed with interest and some amusement the comments on the quaint old illustrations depicting the infancy of the machine-tool industry. I inclose a set given me by a friend. Figs. 1 and 2 are especially interesting because of the touch of human nature displayed therein. Note the surly look of turner No. 1 as he is bracing himself to keep from being hurled over his lathe when his "hook" gouges and enviously watches No. 2 who, with one hand in pocket, smiles nonchalantly in return as if to say: "What are you sweating about, pal, look how easy I take it!"

These illustrations of the crude beginning of our now marvelously developed machine tools seem to prove that more progress has been made in mechanical invention in the last 50 years than in all the ages previous to that. Compare the primitive "wheel-cutting" machine with one of our modern automatic gear cutters! And the lathe hands who growl when the lathe turns or bores a few thousandths taper should observe the turner of 50 years ago with his hook tool and handsledge to adjust his dead-center and should feel consoled that they are living in an age where they don't have to clamp down their feet to keep from being thrown to the ceiling when they turn a shaft.



ILLUSTRATIONS OF PROGRESS IN MACHINE TOOLS

[The illustrations of the star feed as well as the method of gearing the screw of the slide rest from the work itself are particularly interesting as showing the early conception of these devices. These are evidently all the work of James Nasmyth.—Ed.]

# What the Steel Corporation Has Done to Prevent Accidents*

By William H. Tolman†

The United States Steel Corporation, through its owned and subsidiary companies, operates some 150 plants for making steel and all kinds of steel products, and, in addition, many iron and coal mines, several railroads engaged principally in the transportation of iron ore and coal, and a line of steamships which carry iron ore from the ore docks at the head of Lake Superior to the lower lake ports for delivery to the furnaces.

From the early organization of the subsidiary companies of the United States Steel Corporation, special departments to deal with accidents to their workmen were organized, so that they might deal directly with their injured men. Their casualty departments have devoted themselves not merely to the settlement of claims, but have given constant and careful attention to the prevention of accidents. Every accident has been exhaustively investigated to determine its cause, always seeking means for preventing a recurrence of the same kind of accident. Complete records are kept, and where accidents of similar character appear on the records, special inquiry is directed to these accidents with a view to finding out how the dangers which they show can be avoided. Regular inspections and reports have been instituted, rules put into force and warnings emphasized. In each company, a force of experienced men constantly strives to provide more effective safeguards for machinery and to eliminate sources of danger. Some companies hold regular meetings of foremen to discuss the prevention of accidents; others have committees of workmen selected each month to inspect the mills by departments and suggest ways of promoting the safety of the workmen; some offer prizes for suggestions for practicable safety devices.

Provision has been made for first aid at the mills and for the treatment of injured men in hospitals close at hand, by good surgeons. Payment is always made to the public hospitals for the treatment of men injured in the service of their companies. It cannot be alleged with truth that injured men from the mills and plants of their companies have been a burden to the public. Payments received from these companies and contributions made by them have helped to support the public hospitals in the vicinity of their works, so that the injured men may not be a burden on the public.

At a meeting held at the office of the United States Steel Corporation in May, 1906, two days were given to the discussion of problems connected with accidents to the workmen. The question which chiefly occupied consideration was that of preventing accidents. Different methods of inspection, of guarding machinery, of testing chains and other appliances, of instructing workmen and of encouraging foremen in avoiding accidents were discussed in the light of what experience each company had gained in its own endeavors. Each learned something from the experience of the others, and a considerable impetus was given to the work of all the companies toward solving the problems presented.

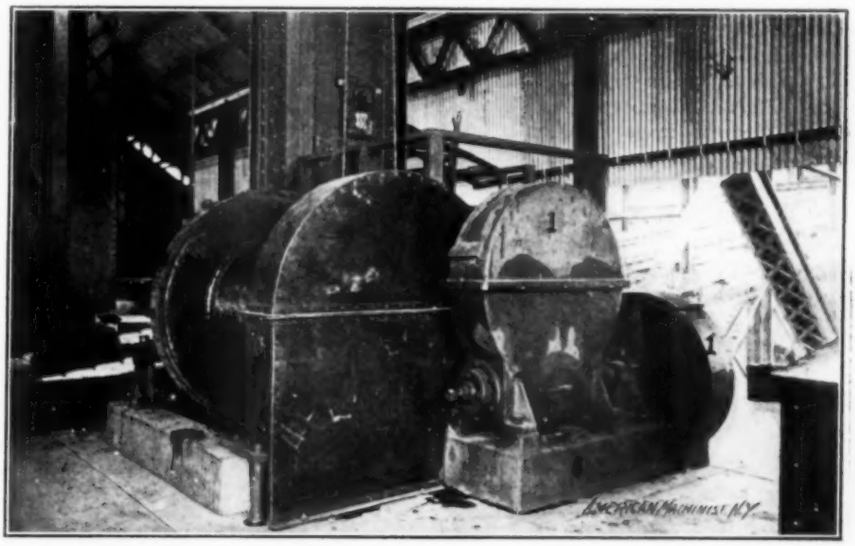
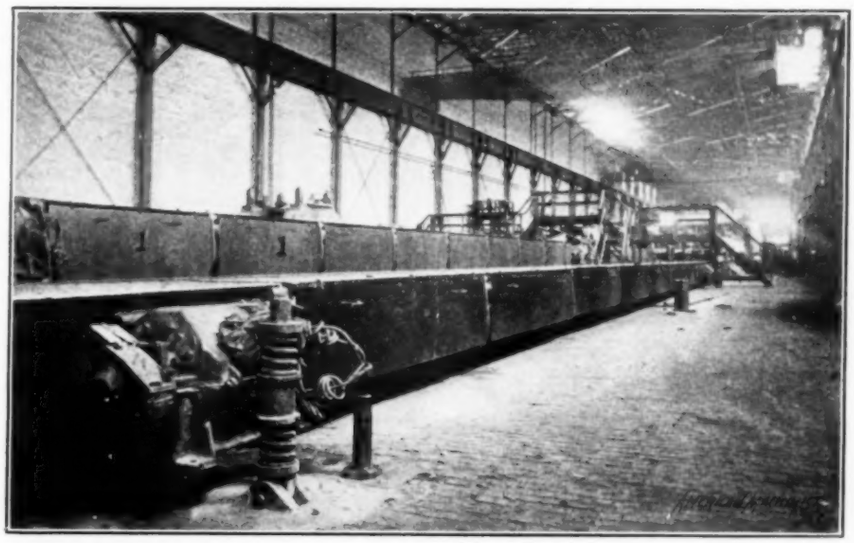


PLATE GUARD OF GEARS OF A HOIST



RAIL MILL SHOWING METHOD OF GUARDING GEARS AND SHAFTING ALONG THE RAIL RUNS

### Establishing of a Committee of Safety

Two years later, in April, 1908, a second meeting of the managers of the casualty departments of the subsidiary companies was held in New York. Again, two days were devoted to the discussion of problems connected with accidents to workmen. The experience of each company during the intervening time was carefully considered. As a result of consideration during these two years, there was evolved a plan for a Central Committee of Safety to act independently of any of the casualty departments. This committee was to complete and perfect a plan for inspecting, on its own account, the different plants and works of the subsidiary companies, with reference to the best methods of preventing accidents and safeguarding employees. In addition, the committee was to act as a clearing house in obtaining and disseminating information and suggestions tending toward the prevention of accidents and safeguarding of employees. The committee was given power to select independent inspectors to act on its behalf. They were to make written reports of the conditions at the different plants and works, with reference to their

*Condensed from a paper read at the twenty-second convention of the International Association of Accident Underwriters.

†Director, Museum of Safety and Sanitation, New York City.

methods of preventing accidents, and to make suggestions for further means for better safeguarding of the workmen. After the receipt of such reports and recommendations, the committee was authorized to transmit them to the proper representatives of the companies concerned, requesting these persons to submit, within such time as the committee might fix, returns showing what action had been taken upon such reports and recommendations.

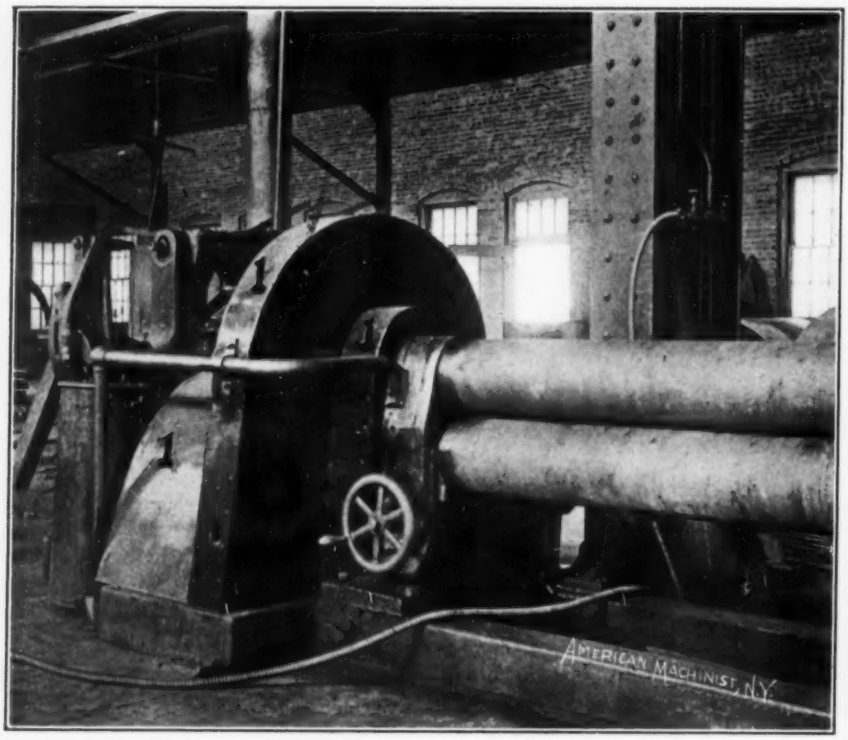
This committee put into operation immediately a most effective system of independent inspections, selecting men familiar with the machinery and operations of the different subsidiary companies and sending them to inspect the mills and plants. These inspectors were also men of experience in matters connected with accidents, competent to detect sources of danger and able to devise means of avoidance. They report directly to the safety committee. Their reports are exhaustive, taking up each building in the plant and covering it in detail. They call attention even to the smallest sources of danger—worn floors, material piled carelessly and windows which should be cleaned to give better light; their comments cover even loose planks which workmen have left where they might fall; railings, ladders, footwalks and set screws are given the most careful scrutiny. Their reports and recommendations are gone over with care by the safety committee and are then sent to the proper representative of the company operating the plant in question. The committee requests the company to submit, within thirty days, a return showing what action has been taken to carry out the recommendations of the inspector; or, if objection is made to any recommendations, on what grounds. At the next meeting of the safety committee, these returns are taken up and discussed in detail. Where objection has been made to any recommendations and the reasons for such objection do not seem to the committee sufficient, the representative of the company concerned is requested to appear and explain the matter. Whenever it seems necessary, the committee, or one or more members delegated for that purpose, makes a personal inspection of the plant with regard to any points in dispute.

### Work of the Committee during Six Months

In six months, the committee has had thirty-seven of the largest plants thoroughly inspected! It has received and considered no less than twenty-six hundred recommendations made by the inspectors. More than ninety-two per cent. of these recommendations were accepted and complied with by the companies interested. Less than eight per cent. required any additional discussion.

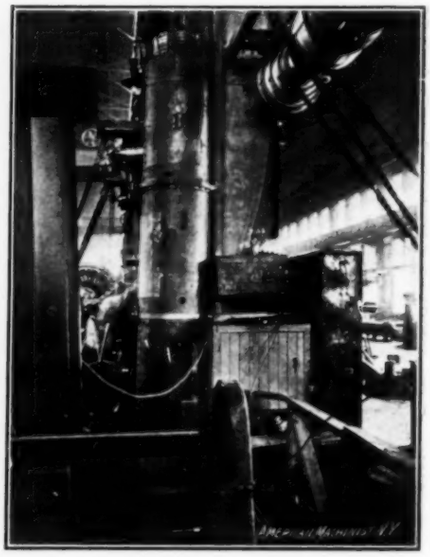
In fulfilment of its further usefulness as a clearing house for information of value in the prevention of accidents, the committee, during the first six months of its existence, received from the different subsidiary companies more than thirty-nine plans of new devices and appliances for safeguarding machinery, warning employees, and otherwise preventing accidents. These suggestions came in the form of letters, stating the experience of the several subsidiary companies in connection with different kinds of accidents due to causes which might exist in other plants. These letters reported various kinds of guards for machinery, which had been found effective. The letters were accompanied by blueprints, photographs, estimates of cost and all information necessary to enable other companies, where similar conditions existed, to install such devices for the prevention of accidents. These data were carefully considered by the committee and transmitted to all the companies where similar conditions might exist, with recommendations from the committee regarding the different suggestions. By subsequent inspections, the committee is enabled to tell how fully these different devices have been adopted.

It has been impossible to obtain complete records showing the entire amount that has been expended in carrying out the recommendations of the safety committee, yet the reports thus far received show expenditures of not less than $30,000 in the six months, for additional




GUARD OVER GEARS OF PLATE STRAIGHTENER

CAST-IRON GEAR GUARDS FOR RAIL MILL PRESS



PIPE GUARD FOR COUNTERWEIGHT ON BORING MILL

safeguards and methods of preventing accidents! This expenditure is in addition to the large sums which the subsidiary companies have spent and are constantly spending on their own initiative for better safeguards.

In December, 1908, a third meeting of the casualty managers was called, to consider the results of the work of the safety committee. At this meeting, the men who made inspections for the committee were in attendance and gave the results of their actual experience in the course of their inspections. The plan was deemed successful and its continuance decided upon.

### Standardization of Safety Devices

This safety committee is now endeavoring to standardize those safety devices which are in use upon machinery common to large numbers of different plants. Heretofore, each subsidiary company has worked out its own method of guarding flywheels, gears, electric switchboards and similar sources of danger which exist at all large mills. Often the form of guard adopted has been different even in two plants of the same subsidiary company. An endeavor is now being made to determine, from among the different methods in use to meet certain common sources of danger, which are the most effective and should be adopted at all the mills and plants throughout the organization of the United States Steel Corporation. It is hoped thus to insure the use of only the most approved and effective safeguards, and by familiarizing the superintendents and foremen with these safeguards, to bring about their ready adoption everywhere by operating men themselves, even without the request of the safety inspectors.

The accompanying illustrations show safety devices installed at the Gary plant.

---

The exports from the United States to Japan have practically doubled in the past ten years. The total Japanese imports from the United States amounted to $39,000,000 in 1908.

## Square Thread Taps

By Walter G. Groocock

One of the many problems of the modern machine shop is, how to produce square threads cheaply, and, although the thread-milling machine has helped solve the question of cutting the external thread we still have the problem of the internal thread to face. Some, of comparatively large diameter, can be tackled on the thread miller, but generally one is compelled to fall back on tapping. Nearly everyone is ready to condemn the square-thread taps that are made, yet few come along with better ways of making them, so with the intention of promoting a discussion on this subject, I am sending along a description of our present method, trusting that the interchange of ideas may develop a better tap.

We had for some time been making them as described by M. M. Sharp in the

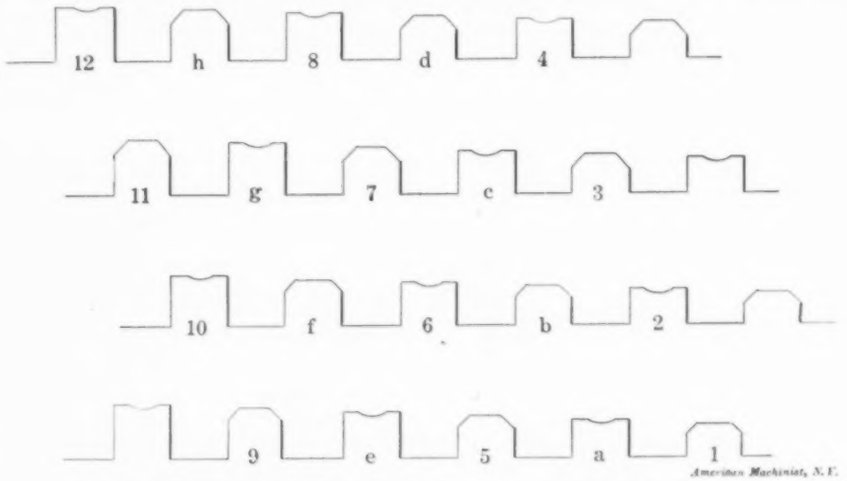



DIAGRAM OF THE NOTCHING OF A FOUR-FLUTE DOUBLE-SQUARE THREAD TAP

American Machinist for October 26, 1904. It may be remembered that the taps then described were five in number, starting with a V-thread and gradually developing into a square, the second and third taps having a threaded guide end to assist in starting. These taps, while being an advance on our previous practice, left much to be desired, for the old failing asserted itself in the breaking of the teeth when nearing the full depth. The position is this: in a V-thread the lightest work is done at a point farthest from the tap body and the heaviest duty near the body, while with the square-thread tap all the work is done at the end farthest from the supporting body.

While thinking of this matter I conceived the idea of notching the corners of alternate teeth and taking out the center of the others, so lessening the chance of breaking by splitting up the work. The first tap I made on this plan was a partial failure through an unexpected cause which should have been foreseen, and on account of the failure may be interesting. The tap, 1½ inches in diameter, three threads per inch, single thread, had five flutes, but instead of the thread being 1/16 inch deep, it was only 1/10 inch, so it was decided to make one tap do the work; the tap was made 20 pitches taper with a total length of thread of 9 inches. To make it cut freely, we machine-relieved the teeth all over and notched it similarly to the development of teeth shown in the diagram. The mistake was in relieving the sides right up to a cutting edge, because it required more skill to start the tap properly than when the sides were unrelieved. The reason is this, once having forced in a square-thread tap that is not relieved on the sides, the part cut acts as a nut and pulls the tap in, whereas, if the tap will cut on the sides, the tendency is for it to go round in a circle in the same plane rather than follow its proper course of a spiral. This tap was given up owing to the difficulty in starting it, and a new one was made (with three flutes to insure strength) which was not relieved on the sides. It worked well, doing some hundreds of holes.

The method of notching was as follows: When the tap was relieved on the top the turner changed his relieving cam for another which would give twice the "jump." He also changed the ratio of his cam shaft gear to give three "jumps" in two revolutions instead of three in one revolution. Then, starting six pitches from the end, he took off the corners of one tooth, missed the next, and so on, up to two threads past the finish of the taper; he then took the center out of the corresponding teeth left square, with a round-nosed tool. Referring again to the diagram, which is a part development of a double-thread tap with four flutes, it will be seen that each tooth as you follow round alternately is cut out at the middle and corners of the threads. By using this system we were enabled to cut down the number of taps in a set from five to three. The notching can easily be applied to existing taps by grinding, and where a relieving lathe is not at hand any toolfitter can file the notching; the parts where filed away being non-cutting edges do not require any particular degree of accuracy.

The taper of the taps in a set should be at least 26 pitches long; thus, for ¼-inch pitch taps, single thread, we should require a minimum of 6½ inches of taper; therefore two taps 4½ inches long on the thread would give us 7½ inches of taper and 1½ inches of parallel length.

The above system of notching is suitable for single-thread taps with an odd number and for double-thread taps with an even number of flutes.

I have not made a double-thread tap with odd flutes under this style of notching, but a set already made started to shed their teeth, and by grinding the corners off slightly different to that shown, the life of the set was prolonged.

# Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

## WE PAY FOR USEFUL IDEAS

### Supporting Devices for Automatic Turret Machine Work

In a good many cases difficulties are experienced in the handling on the turret machine of parts which are supposed to have absolutely correct gage-measurements after passing the machine. With some of the indexing fixtures made for such jobs, where tools are operating on at least two sides of the piece at once, there is difficulty in getting sufficient pressure in the support to prevent the work from moving. Very often it is easy to meet the difficulty by means of a stop upon the opposite side of the work, as in Figs. 1, 2 and 3.

The nature of the work and machine, of course, requires that this backstop have an automatic action, it being brought against the work and locked before the tools arrive and also unlocked and drawn back after the operation is performed, so that the turret can turn without interference.

The work is held tight in the fixture of the turret head; the tools and backstop *a*, Fig. 1, are attached to the sliding heads, and moved by cams against the work. The work may be drilled and roughfaced at the first operation while the other operations are supposed to be suitably divided around the circumference of the turret head.

The first operation starts: The left-hand slide brings backstop *a* by means of friction holder *f* located in locking-piece *c*, against the work, so that stop *a* is left in position by the tension of *f*, which slides farther forward with the sliding head. Afterward the oblique locking surface *e* acts upon lever *c*, forcing pin *d* with sufficient pressure upon stop *a* before the tools on the right-hand side of the work start operations. The shape of the end of stop *a*, which contacts with the work, is made to conform to the nature of the tools.

The left-hand sliding head in returning after the work is machined, unlocks pin *d* as soon as locking-block *e* leaves the end of lever *c* while the stop is set in readiness for the next part. When unlocked, friction sleeve *f* takes stop *a* back with it the rest of the way. A spring dog *b* engaging slot *g* of stop *a* causes a knock at the end of the slot if the sleeve *f* should not act properly. In this case the tension of the spring must be regulated by the operator.

The design in Fig. 2 differs from that in Fig. 1 in that the backstop *a* is moved against the work by means of spiral spring *h* whose tension can be regulated by nuts *i*. Dog-screw *k* in locking-piece *e* engages slot *g* of stop *a* the same way as in Fig. 1, bringing the stop back with it after locking-pin *d* is released. Sometimes the one design may be preferable to the other.

Lever *o* turning around stud *p* is engaged by cam *r* acting on roller *q*. This cam, tightened on the sliding head, unlocks key *l* during the return motion, by acting upon roller *m* through lever *o*. When opened, screw *k* of the sliding head acts upon the end of the slot *g* in the backstop *a*.

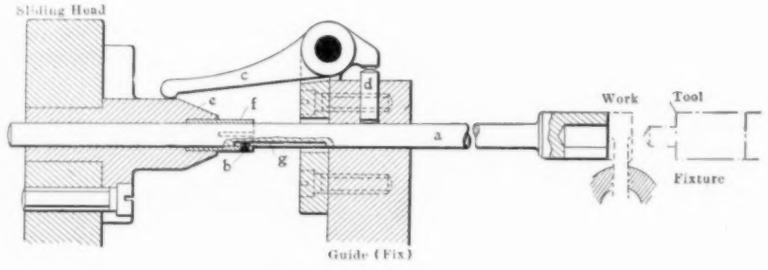



FIG. 1

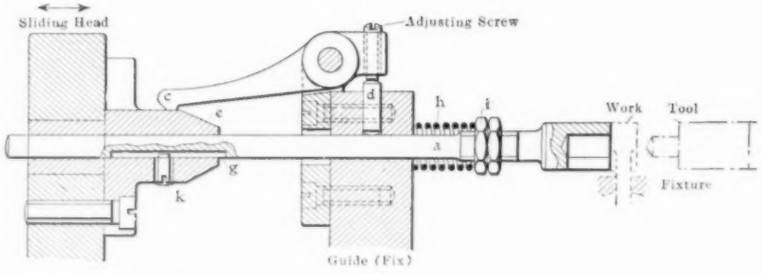



FIG. 2

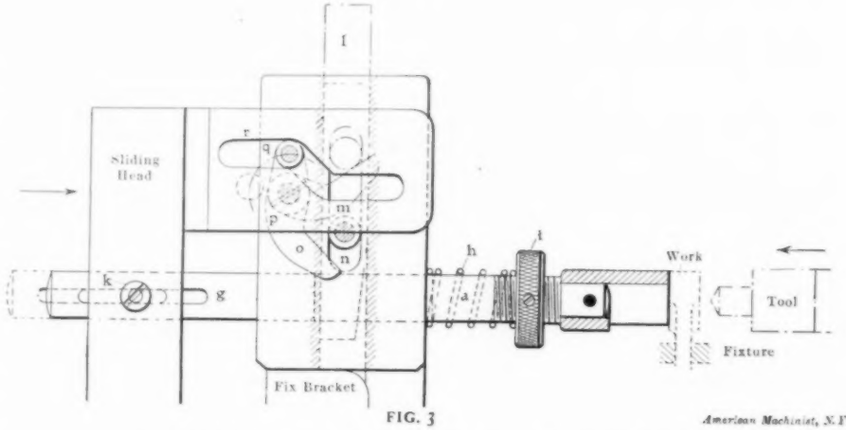



FIG. 3

American Machinist, N.Y.

SUPPORTING DEVICES FOR AUTOMATIC TURRET MACHINE WORK

In cases where pressure of the tools upon the work seems too high, it is best to use the design in Fig. 3. The movement of the backstop *a* is the same as in Fig. 2, but the locking is done by means of key *l* falling into a suitable hole in stop *a*. This key, provided with stud and roller *m*, is located in a guide bracket with slot *n*.

It is obvious that lever *o* should not touch roller *m* of key *l* while the operation is being performed. Further, cam *r* (of suitable form) can act directly upon roller *m*, but this arrangement would require a longer travel for the sliding head. The key also can be brought into the hole in stop *a* by spring action.

Elizabethport, N. J. G. J. JEHLE.

## What is the Action of a Lubricant or Coolant on a Turning Tool?

I would be grateful if some of your readers could suggest a theory for the action of a lubricant on a turning tool that would bear the test of experiment. The theory most often encountered in books is simply that the lubricant is not a lubricant, but a cooling medium. The other theory seems to be that it combines the functions of lubricant and cooling medium.

To the first the practical objection lies that a cooling medium like water or soda water gives results inferior to those obtainable with soap and water, and far inferior to those obtained with lard oil. This inferiority shows itself in the surface speed attainable, the life of the tool and the finish of the work.

The second theory is probably correct, but the exact manner in which the lubricating effect of the liquid affects the result is not clear to me and the test books on lubrication do not seem to give any satisfaction. It is hard to believe that oil can creep into the openings between the tool and the chip, or work against the direction of motion of chip and work and act as a lubricant on the points of actual contact. If this does not take place, however, the "oiliness" of the bath can have no appreciable effect on the life of the tool, the finish or the maximum surface speed. The specific heat, the temperature and the conductivity of the liquid would seem to be the only factors that should be considered. We thus are forced by the proven facts of the case, to assume a certain amount of creeping of the liquid (at least if it is oily) and the question then is: "How does it do it?"

It would be well to state that in all this I am unconsciously assuming the case of turning mild steel in a lathe or screw machine.

Granted that the oil or liquid is in some way drawn or creeps in under the chip and part way between the surfaces in contact, why is it that experience shows lard oil to be the best? What property or quality or combination of qualities renders it by far the best lubricant for turning mild steel? Until the action is thoroughly understood we have no certainty, save that of experience, that it is the best. Would a less viscosity enable it to be drawn in or creep in farther? Would a greater viscosity enable the film to stand greater pressure? Would an oil combining more "body" or "oiliness" and less viscosity be better if such an oil could be obtained?

In what direction should we work in the future to try to find better material, and what qualities shall we insist on in the oil we now buy?

The possibility of reducing the viscosity of lard oil by thinning with a small percentage of kerosene and getting better results on steel was determined by experiments on several mixtures. These experiments prove either (a) that the loss of oiliness due to such thinning more than offsets any gain in the penetration, due to lower viscosity, or (b) there is no gain in penetrating power due to lower viscosity. The results showed the life of a tool to be progressively shorter the more the lard oil was thinned.

It is my intention to try in the other direction soon, namely, *increasing* the viscosity.

The hardness and the ductility of the metal being turned seem to exert a great influence on the character of the lubricant necessary. The fact that lard oil mixed with kerosene is better for aluminum turning (two shops I know who work a lot of aluminum use kerosene straight; not the most highly refined) leads me to suspect that soft and ductile metals flow more closely around the cutting edge than harder or stiffer metals. Is there perhaps a splitting action, running *ahead* of the tool, this action being sufficient while the chip is in motion to form a cavity with a tendency to draw in the surrounding medium? Is this action less in aluminum, requiring thus a more fluid medium than steel?

I was recently told that any fool could ask questions no wise man could answer. I hope the fool has not so distinguished himself in this case.

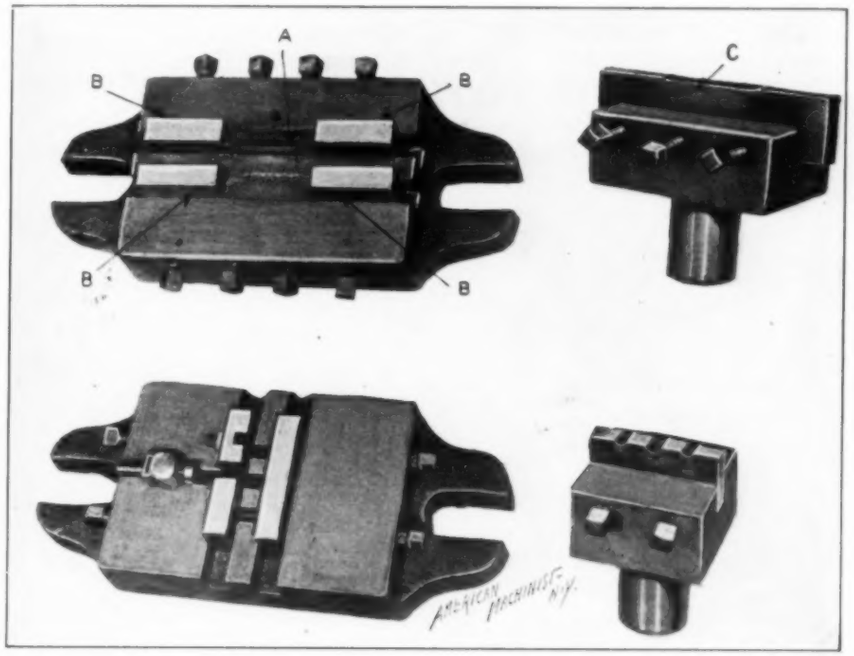
A. H. A.

Oak Park, Ill.

## Shears for Spring Steel

The halftone shows two pairs of shears that proved to be very successful on our work. We had a large quantity of 1/32x1¾-inch spring steel to cut and had great difficulty in making the ordinary shears in the punch press cut such thin, hard stock.

I made the upper pair of shears in the halftone for that work and find them all right, not only for the 1/32x1¾-inch spring steel, but also for ¼x1¼-inch tire steel, of which we also have a good deal to cut. I took a cast-iron die holder and milled two grooves lengthwise in it ½ inch wide, 9/16 inch deep and ½ inch apart. I then fitted four pieces of ½x1⅛x2-inch tool steel *B* for guides and a piece *A* ½x1x2 inches for the lower shear.




SHEARS FOR SPRING STEEL

These were all hardened and fastened in place with ⅜-inch set screws, leaving a vacant space opposite *A*.

I then milled a ½x9/16-inch groove in the punch holder and fitted a piece of ½x1¼x6-inch tool steel *C* for the upper shear. This piece was then hardened and secured in the groove with set screws.

In operation the punch holder is set in the press so that the shear *C* will come down between the guides *B* to just below the upper edge of *A*, yet leaving plenty of room between *C* and the die casting for the stock which is cut off at *A*.

When dull the pieces *A* and *C* are the only ones that have to be ground. The lower shear in the halftone is made on the same principle, but is used for round stock up to 17/64-inch drill rod.

I have used the principle of a support or guide to keep the upper shears from springing away from the lower one several times, and I find it well repays the extra time and steel used.

Sparta, Mich. C. E. MARTINDALE.

## An Outboard Support and a Parapneumatic Pulley

I have been in a number of machine shops in my time and have seen a number of so-called "outboard supports," but the only one worthy of the name, shown in Fig. 1, I saw recently in the Philadelphia Gear Works. It is on a rack cutter where it was put several years ago to facilitate the cutting of extra long racks not possible on this machine previous to its installation. As its name implies it is a piece of *board, out* on one end of the machine. It was *bored out* for two iron bushings and is held from sliding by two collars on the outside and the two gears which it keeps in mesh on the inside. It is thus as shown, not only an *outboard* support but a *bored out* support q. e. d.

There has been a lot written about belt slippage due to the air drawn in under belts at high speeds. Pulleys with high sounding names—parapneumatic and the like—with holes and slots in their rims, have been devised to overcome the evil effects of air between the pulley face and belt.

In Fig. 2 I show a new form of parapneumatic pulley used in this same shop.

Several years ago a certain sized pulley was wanted in a hurry for the machine shown. A cast gear was the only thing instantly available, so it was put on and is there yet doing good work. Cut the belt? Not in the least, the belt is apparently as good now as when it was put on sometime ago and I'll bet no air gets trapped under it. E. A. DIXIE.

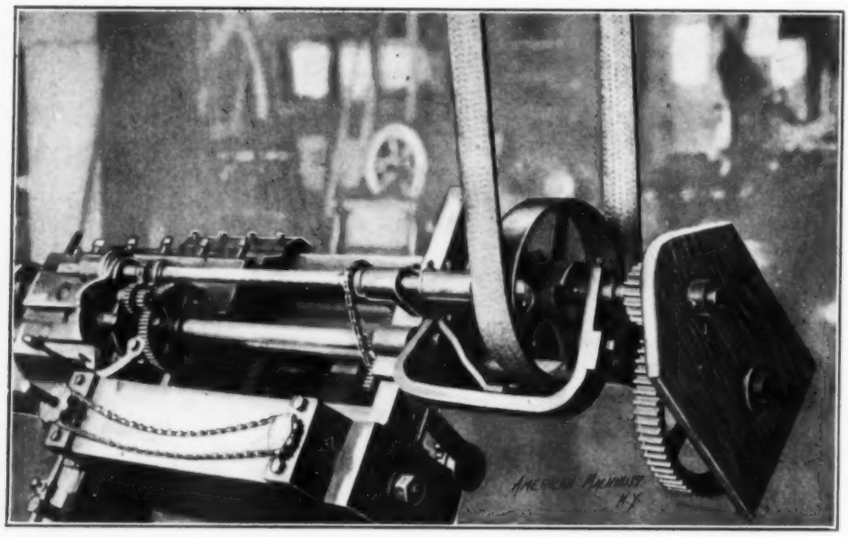


FIG. 1. AN OUTBOARD SUPPORT

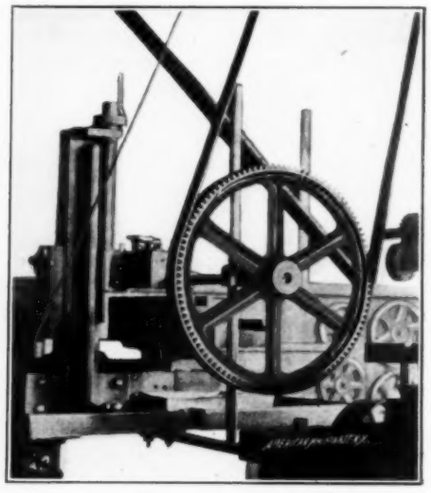


FIG. 2. A NEW FORM OF PARAPNEUMATIC PULLEY

## Another One-man Shop

A while ago a contributor to the AMERICAN MACHINIST wrote about the ups and downs of a one-man shop and the hopes and disappointments of its owner. I give you a glimpse into another one-man shop and tell you something of its proprietor.

My friend, Ben, was one of the many ambitious young countrymen who left the farms of New England some 35 years ago for the larger opportunities of the towns and cities to learn trades which commanded wages much higher than those paid to farmhands.

A long and faithful apprenticeship he served in one of those little old-time machine shops where everything was done directly under the eye of the proprietor, where the closest economies were practised, and where the men developed into "all-round hands," able to tackle any job that came their way.

For years Ben worked at his trade in various shops, gaining experience and adding greatly to his knowledge of the business.

A few years ago, during a dull time, the shop he was working in failed and went out of business. He could find nothing to do as the depression was general, and most shops were running on half time or worse. Besides that, he was now being classed as an "old fellow," and nobody wanted to hire "old fellows," because they are slow and uncertain.

It was at this time, during a visit to his old-home community, that he saw the opportunity of establishing a small repair shop and hardware store on the outskirts of a neighboring town of a few thousand inhabitants.

He bought a small house and half an acre of ground on the principal road leading from the town. There he put up a small building with a store in front and shop in the rear. A lathe and other light machinery and tools were installed. Then he began to advertise:

"If it's busted take it to Benny's."

The jobs that come to Ben's shop are of the most varied character. They range from making a new door key to repairing a traction engine. All's grist that comes to his mill—or shop. He rejuvenates superannuated lawn mowers, sharpens scissors and skates, files and sets saws, repairs bicycles, sewing machines, pumps, cream separators, farm implements of all kinds—anything breakable. A number of cheap sign boards bearing the slogan,

"If it's busted take it to Benny's,"

nailed up at cross-roads and other prominent places, has spread his fame all over the locality. This, together with his natural cheerfulness and willingness to help anyone out of a difficulty has resulted in keeping him profitably busy.

Don't imagine Ben is making "a million a minute" in his little shop, for he isn't. The money he saved while working for others he has invested in this little place where he and Mrs. Ben live quietly, helpful to the community, getting a part of their living from the shop and store and much more of it from the large fruit and vegetable garden which occupies most of the half-acre plot, which gives that great satisfaction when you know it's your own.

This man had reached the time in life when he was regarded as a "has-been." Nobody wanted to employ him because he was getting old and slow. Instead of accepting an undesirable job at less remunerative wages and going on down the slide with the "has-beens," this man pulled up his tent pegs and moved out in the country where living is cheaper and where he could couple his early training as farmer with his trade of machinist and finish out the latter years of his life in comparative ease and comfort.

Woodhaven, N. Y. C. A. C.

# Discussion of the Previous Question

## Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

## WE PAY FOR THESE ALSO

### A Variable Speed Invention

It was with a great deal of amusement and self-satisfaction that I read Mr. Osborne's article on the new variable-speed device invented by his unmechanical friend, as I too had a similar experience under almost the same conditions; the devices varied only in construction, namely, the fiber and wood blocks were changed to a common geared oil-pump principle with a regulating valve. As Mr. Osborne asks for light on the subject, I am only too glad if I can be of service to one who has given me many pleasant and profitable hours of reading in the AMERICAN MACHINIST.

Figs. 1 and 2 are rough reproductions from memory of the device as presented to me. The shaft $A$ was a continuation of, or supposed to connect to, the engine shaft, $B$ the valve connection, $C$ the casing, and $D$ the connection to the propeller shaft which was really a part of the casing. In starting or stopping the engine the valve $B$ was supposed to be wide open so that all oil pumped from the reservoir $F$ to the chamber $E$ could flow back through a passage and the valve to the reservoir $F$ without resistance. The speed of the propeller shaft $D$ was to be regulated by the amount of oil allowed to pass the valve and, when full speed ahead was desired, the valve was to be completely closed; there being no outlet for the oil, the gears would be blocked and all would rotate as one mass on the bearings $G$ $G^1$. A clever scheme for a clutch, but a total failure as a means of transmitting power at varying speeds.

It has the advantage over Mr. Osborne's friend's device in not being quite such a central heat distributing plant, as the heat generated could be more easily gotten rid of than with wood and fiber blocks. It does not take more than horse sense to see why any such device is a failure. The same condition exists here as in a cone or disk clutch, except the wear which can be better taken care of. This would not be so serious if the power could be maintained in the propeller shaft for different changes of speed. To make this clear, let us suppose we had an engine mounted in an automobile capable of developing, say, 20 brake-horsepower at 1000 revolutions per minute or 660 foot-pounds per revolution; this connected to the above device. The available power would only be equal to the pressure in the chamber $E$ through a certain distance just the same as the friction between the surfaces of a cone clutch. For convenience we will consider the pressure in the chamber $E$ to be 660 pounds through a circumference of 1 foot, at full speed of the engine or 1000 revolutions per minute we get 20 horsepower, now open the valve enough to reduce the speed 25 per cent. or to 750 revolutions per minute. The pressure too would be reduced in the chamber $E$. Suppose also we consider this reduced 25 per cent. we would have

$$\frac{495 \times 750}{33{,}000} = 11.28$$

horsepower available at the propeller shaft. Again reduce the speed to 50 per cent. of the original, or 500 revolutions per minute

$$\frac{330 \times 500}{33{,}000} = 5$$

horsepower; at 75 per cent. we have

$$\frac{165 \times 250}{33{,}000} = 1.25$$

horsepower. With the valve wide open there would be no pressure in the chamber $E$, except the slight frictional resistance of

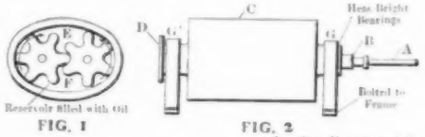


FIG. 1 FIG. 2

A VARIABLE SPEED INVENTION

the oil through the valve and passage, hence no turning moment. The casing $C$ would stand still while the engine shaft and gears ran at a constant (full) speed, taken care of by a governor when the load was taken off.

I started to explain this to the would-be inventor (he called himself a mechanic too) but his mind was too full of visionary dreams of quickly becoming a millionaire to listen.

I think Mr. Osborne and myself could feel just a little better about the abuse we have to take for being technical men, could we but see one of these individuals in an automobile equipped with one of his wonderful devices between two hills that could not be made on the "high," in the midst of a good thunderstorm. We would at least feel the satisfaction of not having to humiliate ourselves by ignorance of the first principles of mechanics.

From time to time for nearly 20 years the device above described has been turning up at the Patent Office in Washington. It would not be out of place here to say that if anyone has gotten up something he believes to be of value and has faith in the Patent Office as a protection, I would advise him before filing an application, to search the Patent Office records for a like device. Records can be found on file in any large public library and a copy of whatever he wants can be had in which he will find a full description including drawings.

H. TERHUNE.

Hartford, Conn.

### Mechanical Signals versus Train Orders

The article recently appearing in the AMERICAN MACHINIST describing an electropneumatic interlocking switch and signal system brings to the mind of an ex-railroad man the vast difference between the old and the new methods of controlling trains.

To get a clear idea of the progress made in the handling of trains it is only necessary to glance back into the past a dozen years or so and contemplate the delay and confusion that would result today were the old methods still in use.

With few trains compared to those now run, with much smaller motive power and consequent slower time the old-style methods answered the purpose, but they would not and could not fulfil the demands made upon them by the multitude of trains now run and the present schedules maintained.

All or most of this new and complicated interlocking switch and signal equipment is of comparatively recent installation. Actual need for it brought it into being.

Consider the old way of running a railroad. Take, for example, a four-track road with a fair traffic. We have the main tracks, Nos. 1 and 2, and the slower or subsidiary tracks, Nos. 3 and 4. A local passenger train running on track No. 1 has fallen behind its schedule. Coming along after it some miles back is an express train, with no stops to make, running on a fast schedule.

The despatcher calculates that he will have to run the local train on track No. 3 at a certain point and, as provided by the rules and regulations, he tries to send a written telegraphic order to the operator at that station directing the local train to take track No. 3. He calls and calls the station wanted, but the operator, having other duties to perform, fails to hear the telegraph instrument. He may be checking trunks, or he may be doing any one of

a dozen things somewhere around the station. Result: the despatcher has to fall back on the next station and send his order for the local. The operator takes a red flag and sticks its metal point into a tie between the rails of track No. 1 and then awaits developments.

When the local finally arrives with the express crawling along behind it, and losing time every second, the crew amble to the office, get their order, read it over three or four times and, walking up the track, throw the hand switches. Finally, with a coal-tar-in-the-wintertime movement, the local pulls in on track No. 3, and the express, away off its schedule, with passengers telling one another what a good-for-nothing road it is, goes by.

Now, with the towerman sitting at his desk, the whole interlocking system at his elbow, the despatcher simply tells him to run the local from track No. 1 to track No. 3. The switches and signals are set from the tower, the local comes along at its usual speed and goes right on through the crossover, orders not being necessary. The towerman straightens the track again and the express rushes by on time without a pause. Perhaps this is repeated further along the line, the express finally pulling in at the end of its run "on time."

New York. J. O. SMITH.

[Even with the modern "kinks" we seem to remember more times when the express wasn't on time than when it was. We presume, however, that this is due more to kinks in the schedule rather than those in the mechanism.—EDITOR.]

## Some Comments on Forging and Hardening Steel

It was with considerable satisfaction that I read John A. Matthews' article on page 82. If you will just turn and read the first page, or better still the entire article, and then stop and think how content you would be to sit with your sweetheart or wife or even ride alone, with Louis Strang at the wheel, in a car made of steel forged in your own factory, you will begin to see why we, who have to treat the steel, want the best that science can produce to do our work with.

There are few men who know the worthfulness or treachery of a piece of valuable steel untreated; disregarding the possibilities of its having been misused in forging, before it is machined.

Surely Dr. Matthews' article brings out the fact that it is not only a waste of money to buy steel and be in ignorance of its condition and actions under stress, when put in the working parts of a machine, but also very nearly criminal negligence. We have long been ever ready to condemn the steel maker when a piece of steel gave way, and where it has taken an arm or a life, the steel maker has had to bear the blame.

In an article some two years ago, in the AMERICAN MACHINIST, I contended that I was not able to say that I had found one bad bar of tool steel to 5000 good ones, and I maintain that this holds good today. In citing the above I am not trying to defend the steel makers, for they are surely accountable for a great many costly mistakes.

Just on the eve of writing this article I was called into a conference with one of the leading manufacturers of this country, and imagine my surprise when I found that a representative of the steel mill had recommended their high-speed steel for very rough punching jobs. Should this punch be made of this kind of steel the results will be, not only a broken punch, but a broken set of dies, and possibly a broken machine.

High-speed steel should never be used in work where the stress is liable to be more than a piece of hardened high-speed steel will stand. This punch was to be used on a hydraulic press with sufficient pressure to crumble the punch into atoms.

All valuable materials have a specific place where they will do better than anything else. While in their place no value can be placed on them, but to use them elsewhere they become, not only unsafe, but worthless, and in many instances, treacherous. We should be equipped for the proper treatment of steel and know precisely what the steel will do when placed under stress, as to heat-treat steel means the same to the steel that the cutting and polishing means to a diamond.

We have often been told that to heat and harden steel several times causes it to become brittle and many have been convinced of its truth. Every time, however, a piece of steel is properly heated and cooled, it becomes a better steel from the treatment it has received.

In order to convince the unbeliever, let him take a piece of 1 to 1.40 per cent. carbon steel ½ inch square and remove the scale on all sides 8 inches back from the end, then heat it to 1832 degrees Fahrenheit (bright cherry red), plunge it in brine or water and move it very rapidly until cool. After this dry the piece thoroughly and break it in the center of the 8 inches so the grain can be seen. Treat the rest of the bar as follows: Heat to 1400 degrees Fahrenheit, or very dull cherry red, and let cool to 752 degrees Fahrenheit, (red visible in the dark) then cool in oil. Repeat this heating and cooling three times. Then heat to 1400 degrees Fahrenheit and plunge in water, moving the piece very rapidly until cool. Remove, polish, and draw to 560 degrees Fahrenheit (full blue), then break and compare the grain with the first piece.

This also shows us why it is necessary to heat-treat steel. If it was something that was extremely difficult to undertake, it would then be time to excuse the manufacturer, at least to a small degree. But there is no mystery connected with it as it is all plain work and the results are visible to any who care to look. There is nothing needed to make the discovery but what every machine shop has, and that is fire and water, with a common hand hammer to break the piece so the grain can be seen. To do the work intelligently, however, will require a proper furnace and a pyrometer.

I never knew how to heat steel until I used the pyrometer and find it a necessity to the tool hardener. He can go so far without it but will never fully reap all the possibilities in the hardening of steel until he has one. In work done without the aid of a pyrometer, we may get the full yield of the strength of the steel, but we cannot know it or even expect it.

It will also be necessary to have a furnace that heats evenly, and when directions are given to heat for quenching to 1550 degrees Fahrenheit and draw back to 1000 degrees Fahrenheit it does not mean that we can be 5 or 6 hours heating the steel, nor does it mean that we can guess at the temperature.

When such instructions are given it is presumed that we know how to heat steel without injuring its structure, and we must have a furnace that will give these heats with a moderate degree of accuracy and uniformity. Too much time must not be given in either heating or drawing and at the same time the piece or pieces must not be subjected to more heat than is ultimately desired. Therefore it is as necessary to have a properly designed furnace as it is to have an accurate pyrometer.

I have found the lead bath to be the most convenient furnace for heating steel. I have just finished the designing of a lead bath 50 inches long, 4 inches deep and 12 inches wide. I thought this to be as large as any in use but in making a few visits to some of our leading manufacturers I found a lead bath 15 feet long, 4 feet wide and 18 inches deep. This was used for annealing, and when I asked why they used a lead bath instead of a furnace, I was told that they were able to get a more uniform heat in lead than in an open furnace. Thus I do not stand alone in my opinion as to the lead bath.

The day is fast approaching when steel will receive the proper treatment when forging and heat-treating it. As it is, the majority of manufacturers are skeptical about installing some of the latest apparatus for the treatment of steel. But sooner or later they will awake to the vast importance the proper treatment of steel plays, not alone in the durability of the product but also the accuracy of designing, with the possible reduction of tonnage.

They will then equip this department in a scientific way and it can be called on to furnish articles up to specifications, without any mystery or compounds; in fact

not even a guess will be necessary. Our mills are making the steel that the above can be accomplished with and our manufacturers are buying it at a fair price so there is now no excuse for poor work in the hardening and forging if this department is properly equipped.

Davenport, Ia. C. U. SCOTT.

## Method of Lubricating Gasolene Engines

On page 197 of the AMERICAN MACHINIST, issue of July 29, 1909, I note some comments regarding a gasolene engine brought out recently by Fairbanks, Morse & Co. One of the points particularly referred to is the lubrication.

This method of lubricating gasolene engines has prevailed upon Lake Winnipesaukee, in the central part of New Hampshire, for several years, and I think the majority of the boats on this particular lake have their engines operated by gasolene in which the cylinder lubricating oil has been mixed in the supply bin. The proportion generally used and found to be satisfactory by several years' experience, is one pint of cylinder oil of a medium heavy grade to 5 gallons gasolene.

After several years of operation of a two-cylinder engine, using this method of lubrication, I can frankly state that the method is entirely satisfactory, much more so than the ordinary process of lubrication.

Nashua, N. H. OSCAR M. FLATHER.

## The Use and Calibrating of the Pyrometer

I should like to reply to C. U. Scott's article on page 1061, Part 1.

He asks three questions, the first being: "Why is the pyrometer discarded in so many shops?" I agree with him to a certain extent in his reply that such shops are not properly equipped, but I firmly believe that they are turned out because they are not wanted. These instruments can only be used under certain conditions with any degree of success. They must be handled with care, and be properly looked after, and adjusted periodically to be of any use. In almost any furnace the pyrometer will fail to give the true temperature of the work—it may, however, give the true temperature of the particular spot in the furnace at which the thermo-couple happens to be situated. This is particularly so in large furnaces for reheating ingots and large forgings. The flames play to the top and sides of the furnace—just the places where a thermo-couple can be placed—with the result that the pyrometer records a very high temperature. Various methods have been tried to shield the couple from the flames, and enable it to rest against the job whose temperature is required, but the cutting action is so great with the flames that such screens last no time and are of little use. For small work, pyrometers can be used very satisfactorily in a proper type of heating apparatus, but it is almost essential that there should be no flames, for the reason just given. Such a condition is obtained in the salt bath.

With regard to the materials used for calibrating pyrometers, and the method of using them, by far the safest and best method is to use salts, melting at known temperatures. Such salts can be purchased from the chemical manufacturers and their melting points guaranteed. If one is not satisfied with this guarantee the national laboratories will test and guarantee for one. A range of say six to eight temperatures is required according to the scale required. Used properly these salts can be used time after time with safety. The method of obtaining each point is simple. Procure a small platinum crucible about 2 inches high and 1½ inches diameter at the top, and a small crucible furnace to hold it. Put a bunsen burner with blowpipe attachment under the crucible. Take the couple and strip it of all coverings at the hot junction, and connect the cold junction to the indicator. Suspend the thermo-couple by any convenient means so that the hot junction hangs in the crucible without touching the bottom or sides. Put salts in the crucible and melt by means of the bunsen and blowpipe—enough salt should be used to cover the hot junction end of the thermo-couple. When all the salts are melted, turn off the gas, and watch the needle, which will show clearly the freezing point of the salt. Each point should be found twice to assure accuracy—then the salt should be finally melted and cast into a shallow platinum dish to cool, and then broken up and replaced in the proper bottle. Both platinum dishes and the thermo-couple should be thoroughly washed in clean water after each point is found to prevent combining the salts in any way. The quantity of salt used for each experiment is immaterial so long as there is sufficient to cover the thermo-couple junction. The loss by volatilization is very small indeed. A great advantage in this method is the being able to use a naked thermo-couple, whereby the freezing points are very clearly defined. The small quantity of salts used in a thin platinum crucible is very much easier to melt than if a graphite crucible were used. Metals are poor for use in determining the necessary points, as they oxidize so rapidly and so change their freezing points; they have to be used in larger quantities in graphite crucibles, and, therefore, are hard to melt; and the naked couple cannot be used, and so the readings are sluggish.

However much abused, on some classes of work pyrometers afford a most useful and excellent check on the men responsible for hardening and tempering with suitably designed furnaces.

Through reading Mr. Scott's article I have had all my latent indignation aroused for the individuals who *harden and temper* with the aid of a smith's fire. I am reminded of a manager I once knew who had some trouble with shear blades, some of which were returned from the customers because the edge was soft in places, and brittle in others. They were retreated once, but were little better than they were at first. On being sent back a second time, I had the pleasure of seeing them treated by the manager, who said that their failure was due, without doubt, to the smith's incompetence. He first laid one blade, with its cutting edge in the fire of a smith's hearth, and covered it with coke. The blast was turned on, and the blade heated. After a few minutes it was removed for inspection. The middle was a bright red, and the ends were black—so the fire was broadened, and the blade inserted again, with the result that one end was cherry red, and the other black! After fooling around for some time he managed to get the thing heated all along one edge, but I judged there was a difference of 300 degrees Fahrenheit in the temperature of the various parts. It was gazed at critically for some seconds by the operator and immersed in dirty water, the temperature of which he took most carefully. He said the blade was hard, so he drew the temper by laying it on the fire, and rubbing a lump of mutton suet on it every quarter of a minute. He said, in answer to my inquiry, that he could tell the temperature by this means! The second blade was treated in the same way. Needless to say the blades failed, and were returned as useless. Of course, the steel was blamed, as is always the case. I heard of the same man treating milling cutters in a similar fashion, and wondering at the poor results obtained.

I know of a foreman who was given a special tap to harden and temper. It was about 24 inches long and 1½ inches diameter with the shank about 1¼ inches diameter. He was particularly requested to take great care with it and keep it straight. When it was finished some of the threads were burnt and the whole thing was scaled badly—it was also about ½ inch out of true! He had a decent furnace to work with but he preferred to use a smith's fire and he was annoyed when complaint was made, and said that it wasn't the right sort of work to ask him to do. Which was obviously true.

For treating lathe tools, and the like, the smith's fire is all right, because of the great heat that can be quickly and locally obtained, but for delicate work of any sort it is quite useless, and even people of the above sort are recognizing this fact.

Sheffield, England. "CORAM".

# AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

*CIRCULATION STATEMENT*

*During* 1908 *we printed and circulated* 1,205,750 *copies of the* AMERICAN MACHINIST.

*Our circulation for July,* 1909, *was (weekly, monthly and European)* 110,000.

| | |
|---|---|
| *August* 5 | 35,750 |
| *August* 12 | 19,750 |
| *August* 19 | 19,000 |

*This paper reaches* 35,750 *separate readers each month and* 19,750 *each week.*

*None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.*


## Contents


| | PAGE |
|---|---|
| Unloading Railroad Cars by Machinery | 309 |
| Making Chasers for Landis Die Heads | 313 |
| A Divided Molding Frame | 314 |
| A Comparison of American Aeroplanes | 315 |
| A Short Cut for Figuring Circumferences of Circles by Long Hand | 317 |
| Growth of the High-speed Engine | 318 |
| Boring Bar for Ball Sockets | 320 |
| Efficiencies of Various Cut Gears | 321 |
| Duplicating a Planer Bed | 324 |
| Planing in a Machine Shop | 325 |
| Belt Drive vs. Positive Drives | 326 |
| Principles in Design of Friction Clutches | 327 |
| Collapsible Pattern | 329 |
| Illustrations of Progress in Machine Tools | 330 |
| What the Steel Corporation Has Done to Prevent Accidents | 331 |
| Square Thread Taps | 333 |
| Practical Letters from Our Readers: Supporting Devices....What Is the Action of a Lubricant....Shears for Spring Steel....An Outboard Support....A One Man Shop | 334-336 |
| Discussion of the Previous Question: A Variable Speed Invention....Mechanical Railroad Signals....Forging and Hardening Steel....Calibrating Pyrometers | 337-339 |
| The Immediate Importance of Industrial Education | 340 |
| Fire-resisting Properties of Building Materials | 340 |
| New Tools and Machine Shop Appliances | 342 |


## The Immediate Importance of Industrial Education

The advocacy of industrial education by the manufacturers of this country has no altruistic motive behind it. As we have said in these columns before, the interest of the manufacturer grows out of the fact that, under prevailing conditions, he finds it difficult to get apprentice boys and perhaps more so to keep after getting them. Without attempting to analyze the reasons, it is enough to know that, as things now stand, boys are not anxious to enter factories and some form of industrial education is looked upon as a possible magnet to attract them.

These conditions are becoming more and more acute. The revival of industrial activity, which the information which comes to this office unanimously testifies is in progress, has gone so far that a shortage of skilled help is frequently reported—reports of this kind coming from the East and West alike. There is, moreover, no disagreement in explaining the disappearance of the skilled men who were necessarily laid off after the panic of October, 1907. It is a matter of common knowledge that throughout the period of depression which is now nearing its close the automobile business has been phenomenally prosperous, and it is the universal agreement that the automobile industry has absorbed most of the skilled labor which formerly found employment in machine shops doing other classes of work.

There is no reason for supposing that the activity of the automobile industry will slacken in the near future. In addition to its need of men is the novelty and the undoubted attractiveness of the work to many, and it may fairly be expected that its demands for skilled workmen will increase rather than diminish.

In other words, the situation will not right itself, and, acute as has been the interest in the subject of the training of skilled help among machinery manufacturers in the past, it appears to us certain that, growing out of their immediate needs, this interest must actively increase from this time on. If machine tool and other machine shops are to recruit their forces to the numbers existing prior to the recent panic, it must be largely through their own efforts to train efficient workmen. We do not believe it necessary to urge increased activity in this direction, as we believe that it will be forced upon those who want additional skilled help but who, through ordinary methods, are unable to obtain it. Necessity is the mother of progress as well as of invention and it seems to us certain that the revival of activity cannot go much further without a corresponding increase of interest and activity in industrial education.

## Fire-resisting Properties of Buil Materials

The enormously greater fire waste per capita in the United States, compared with the principal countries of Europe, is too well known to need repeating. The need of reducing this unnecessary and, in fact, almost criminal waste is being emphasized in connection with the broad movement for the conservation of our resources. One way in which to reduce the fire loss of buildings is to adopt fire-resisting building material, and anyone interested in such fire-resisting construction will find material for study in the recent Bulletin 370 of the United States Geological Survey, entitled, "The Fire Resisting Properties of Various Building Materials," written by Richard L. Humphrey.

This bulletin reports 30 tests, on as many different panels of various building materials, at the Underwriters Laboratories, Chicago, Ill., to determine the effect of fire and subsequent quenching by water on the materials composing the panels. These materials were: Common brick, two samples; hydraulic-pressed brick, one sample; sand-lime brick, one sample; mortar building blocks, made on five different kinds of machines, of various consistencies, and with various proportions of the aggregates—a river sand was used and typical portland cement; terra-cotta tile, two kinds; concrete, sections of broken beams that had been tested at the laboratory at St. Louis and containing four distinct types of aggregate, limestone, granite, gravel and cinder; building stone, four kinds, sandstone, limestone, marble and granite. From the foregoing it will be seen that a wide range of materials was used.

Of these materials the mortar building blocks and the concrete beams were made in the structural-materials testing laboratory. The other materials, except some of the common brick, were obtained in the open market at Chicago.

It is not considered that the results of the tests are conclusive, and it is suggested that it is better to consider them as furnishing general information rather than as forming a basis for definite conclusions in regard to the relative fire-resisting qualities of the building materials. However, it is undoubtedly a fact that these results are of considerable importance as a comparison of the action of the various materials under the conditions of the tests. The tests in general consisted in subjecting the materials in a built-up panel to the direct application of heat from gas flame for a period of two hours, and then, with the exception of five cases, of immediately quenching the panel with water furnished by a fire hose and under a considerable head.

Without attempting to present the de-

of materials, design and construction the various blocks, tiles, etc., for which formation we will refer our readers to bulletin, a brief synopsis of some of results can be presented with profit.

regard to the effect of the heat and quenching on natural building stone, we quote from the bulletin: "The serious damage to the various natural building stones precludes any comparison among them." To appreciate the extent of this damage the reader has but to turn to Plates 26, 29, 33, 35 and 36 in order to see dressed granite, marble, sandstone and limestone spalled, chipped, broken, and, in all of the cases with the exception of the marble, lying in a rough heap of broken stone as a result of the heating and quenching.

In regard to the terra-cotta tile we quote: "Large percentages of the faces of the tiles were washed away by the water and the material composing the faces became soft and could be easily crumbled in the fingers. There was a comparatively rapid rise in the temperature of the back of the panel. The plaster on the panel of partition tile fell off a few minutes after the test was started."

In regard to the various kinds of bricks tested, we read: "The brick panels probably withstood the tests better than the other materials. The common bricks tested comprised unused new Chicago brick and used St. Louis brick. Fifty per cent. of the new bricks were split, while 60 to 70 per cent. of the old bricks were not damaged. Lime knots seemed to be responsible for most of the damage to the new bricks, and they were found at the bottom of nearly all the cracks. The bricks at the back of the panels were entirely unaffected. While the strength tests are not conclusive, there is apparently little difference in the strength of these bricks before and after firing. The hydraulic-pressed brick withstood the test very well, no damage is apparent after firing and before the water is applied and, although a number of the bricks cracked, 70 per cent. of them were found to be sound after quenching. The sand-lime brick did not withstand the test as well as expected, but the samples tested, which were purchased at random, appear to be somewhat below average quality."

Taking up the question of cracking of the materials and the behavior of the concrete specimens, we find that, "The concrete cracked least but the test indicated the necessity of using metal reinforcement in concrete walls to distribute the effect of the expansion." Bearing upon the question of the value of concrete as a fire-resisting casing for steel construction and for general fireproofing purposes, we note this paragraph: "A fact brought out most clearly by these tests is the low heat-transmission rate of portland-cement mortars and concretes. This is one of the desirable qualities in materials intended for fireproofing purposes. For marking the cement blocks, linen tags were fastened by wire nails to the interior walls at the time of molding. Most of these tags remained in place during the test and when the walls were dismantled, the tags in every case were found entirely undamaged. The rise in temperature of the backs of the building blocks made of river-sand mortar varied from 77 to 104 degrees, Fahrenheit, while the rise in the average temperatures of the faces of the cement blocks ranged from 1202 to 1652 degrees Fahrenheit. The backs of the mortar blocks made of slag sand showed a rise in temperature of only 30 degrees, Fahrenheit, while the faces were heated up to 1472 degrees Fahrenheit. The low rate of heat conductivity of the mortar blocks is shown by the slowness with which the temperature of the backs of the panels increased in comparison with that of the faces. An average of all the tests shows that about 90 per cent. of the maximum temperatures attained by the faces of the panels were reached in one hour, while in the case of the mortar blocks, the increase in temperatures of the back of the panels in one hour was only about 20 per cent. of the total increase in the two hours. Of the solid concrete panels, the cinder concrete showed the smallest increase in the temperature of the backs of the walls and the granite concrete the largest."

The danger in the use of concrete building blocks designed with insufficient sections of material and composed of lean mixtures is well set forth in this paragraph: "It is apparent that the strength of the webs of ordinary hollow blocks is insufficient to resist the stresses set up in these tests, as in many tests the rapid rise in temperature and a subsequent quenching of one of the faces of blocks caused the webs to split. It was noticeable that the richer the mortar used in these blocks, the better they withstood the test. The amount of water used in mixing the mortars had a similar effect on the fire-resisting qualities. The mortars mixed with the greatest percentage of water gave the best results. This may be clearly seen in the photographs of the mortar blocks after water treatment, where the richer mixtures often stand out apparently undamaged in contrast with the spalled and damaged faces of the leaner, drier blocks. It is quite possible, as was shown in some of the block tests, to make blocks that will pass the conditions perfectly. The web must be thick enough to give the necessary strength."

Comparing the various kinds of concrete used and the results noted from the sections of concrete beams, we read: "It was difficult to determine whether the limestone, granite, gravel or cinder concrete sustained the least damage. The faces of all the panels were more or less pitted by the fire and washed away by the stream of water. The test was unfair to cinder concrete as the cinder was very poor, containing a large percentage of unburned coal. During the fire test, the coal ignited and left the surface of the concrete very rough and badly pitted. The limestone aggregate in the face calcined and the granite aggregate split and broke away from the surface mortar. The granite concrete probably behaved the best. The damage in no case extended deeply, probably not more than 1½ inches. The evidence showed that even at this depth the temperature was comparatively low. The high stresses produced in the panels by the rapid rise in temperature of the faces while the backs remained cool caused cracks. On taking down the panels, the blocks of concrete were found to be cracked vertically for some distance back from the face."

## New Publication

ZUR HERSTELLUNG DER KEGEBRADER. By Edward Linsel. 192 4x6-inch pages; 7 illustrations in the text; several tables. "Der Mechaniker," Berlin-Nikolassee, Normannstrasse 2. Price, 3 marks.

This discussion of the design of bevel gears was taken from the pages of "Der Mechaniker." It explains the methods of computing the proportions of such gears and gives 14 illustrative examples. There are several tables, one of which occupies 140 pages or about two-thirds of the book. This table gives the important angles and factors for ratios from $\frac{18}{18}$ to $\frac{77}{76}$.

## Albert A. Pope

Col. Albert A. Pope, of bicycle fame, died at his summer home in Cohasset, Mass., August 9, after a long illness, which is said to have been brought on by a nervous breakdown following the financial embarrassment of his company two years ago.

Colonel Pope was born in Boston in 1843, and when still very young engaged in farming pursuits. When the war broke out he enlisted and served with distinction, mustering out with the rank of lieutenant-colonel.

In 1876, while visiting the Centennial Exposition in Philadelphia, he became interested in the bicycle exhibit, and from that time his name has been the foremost one in the bicycle world. In 1877 he organized the Pope Manufacturing Company, and remained its president and active manager until its recent failure.

Colonel Pope was naturally an ardent advocate of the good-road system, and his influence in this direction was preëminent.

Upon the advent of the automobile into prominent use his company became engaged in its manufacture, establishing large automobile plants in eight States and building several makes of machines.

# New Tools and Machine Shop Appliances

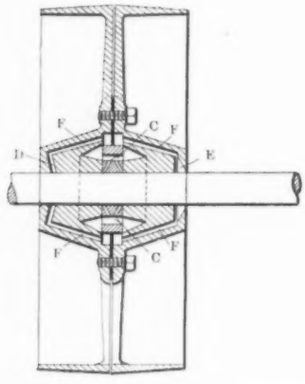
## Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

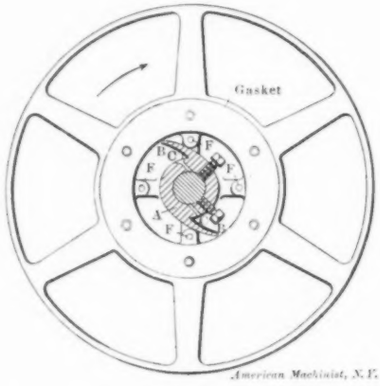
## THE LATEST INFORMATION

### The Maymont Self-Oiling Loose Pulley

This pulley is made in halves, with a combination set collar and oiling collar between. The hub is enlarged to inclose an oil reservoir, as shown. The halves are bolted together with a thin oil-proof gasket between, to prevent leakage. The oil-distributing collar is fixed to the shaft by two set screws, and serves also as a set collar, so no outside collar is needed. In the drawing, *A* is the collar, with its two set screws. All the rest of the pulley is free to rotate on the shaft. The collar has two curved wings or lips *B B* extending outward nearly to the wall of the oil reservoir. Close inside these wings are diverging drilled holes *C C* through the body of the collar, leading to the shaft at each side. Cored into the hubs at their outer ends are the recesses *D* and *E*, the former closed and the latter open, as shown. Connecting these recesses with the central oil reservoir are four drilled ports *F*, diverging from the shaft. As the pulley rotates, these holes, at their reservoir ends, continually pass close to the wings of the fixed collar. Oil in the reservoir, as the pulley rotates, is carried, by the wings *BB* of the collar, to and into the holes *C C* leading to the shaft. Here the oil passes directly onto the bearing surfaces between the hub valves and the shaft, and works along the shaft to the end recesses *D* and *E*, where centrifugal force carries it outward to the ports *F*, and through them back to the reservoir. As the oil returns through all four ports *F*, the wings *B B* of the collar collect it and direct it to the holes *C C*. Thus a continuous circulation of the oil is maintained and ample lubrication of the pulley assured.

As stated above, the joint between the halves is made tight by a thin oilproof gasket. The only other way out for the oil is along the shaft, and centrifugal force cuts off escape of oil at each end at the recesses *D* and *E*. When the pulley stops, the oil in ports *F* above the shaft will drain outward to recesses *D* and *E*, and thence down around the shaft to the standing oil level. New oil is fed in, with the pulley in motion, by inserting at the open end *E* of the pulley, where it at once enters the circulation with the old oil. The maker is the McMaster-Carr Supply Company, Chicago, Ill.




SELF-OILING LOOSE PULLEY

### Some Interesting Transmission Devices

Machinery and devices used in the transmission of power in shops is always of interest and we show herewith some developments along that line by Carl M. Wheaton, 9 Callender street, Providence, R. I.

Beginning with Fig. 1, we have a novel

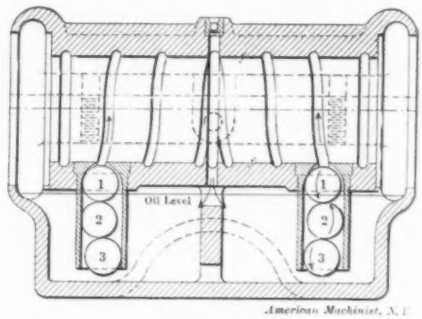



FIG. 1. SELF-OILING BEARING

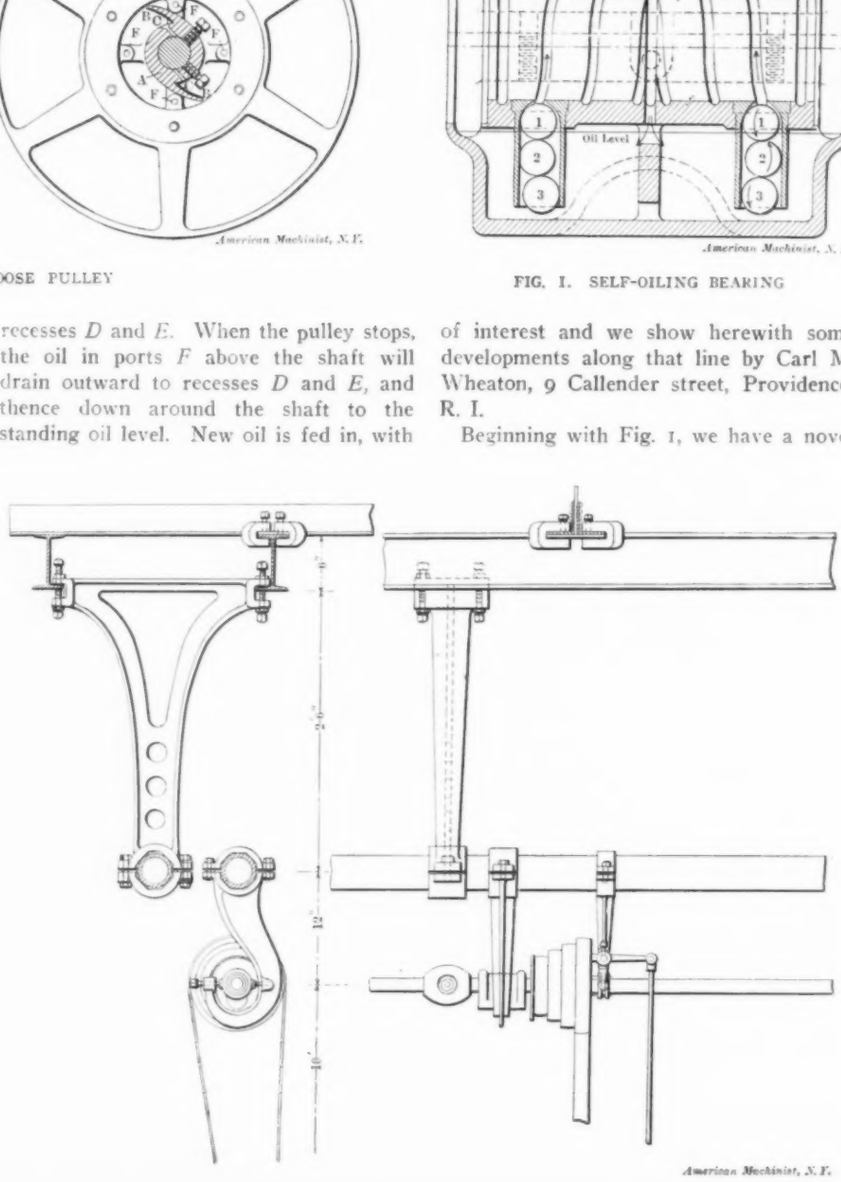



FIG. 2. METHOD OF HANGING SHAFTING IN A HIGH ROOM

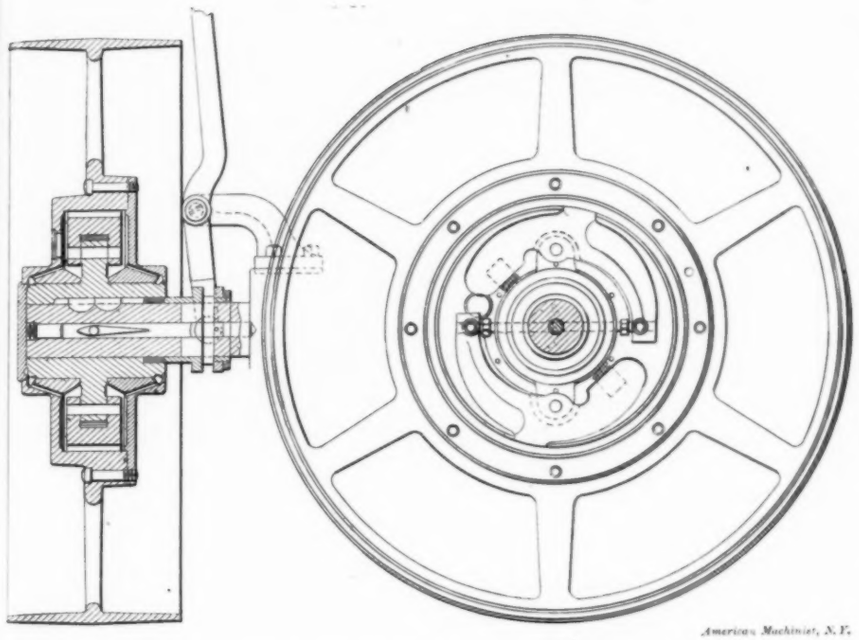



FIG. 3. PULLEY WITH INTERNAL CLUTCH

self-oiling bearing in which the oiling device is a number of cork balls confined in the tubes shown and being held in contact with the shaft by their effort to float on the oil. In this way oil is carried from one to the other and deposited on the revolving shaft by the upper ball. The oil grooves are cut right and left hand, meeting in the center from which the oil returns to the reservoir below, as indicated by the arrows. Any oil which works out at the ends is carried by centrifugal force into the oil-retaining grooves from which it also returns to the reservoir below.

In Fig. 2 we have a method of hanging shafting in a high-studded room, the whole thing in this case being shown as supported from steel floor beams. This needs hardly any description as the pipe which supports the hangers is shown to be dropped three feet from the ceiling and the line shaft to be twelve inches below this. By this method hangers can be placed at any point desired and, as will be seen, this contemplates the use of friction-driven cones on the line shafts, as will be shown in detail in Fig. 4. This obviates the necessity for horizontal belting.

Fig. 3 is a clutch pulley to be used in connection with such a system. This is shown applied to the end of a shaft and the clutch is in the center of the pulley in an oil- and dust-proof opening in the hub. The action of the clutch can be seen from the side view where the cover is removed, and in the sectional view of the hub. As soon as the clutch is released, centrifugal action tends to throw out the counterweight on the back end of the clutch levers and holds the friction surfaces out of contact except when forced into position by the clutch lever.

Fig. 4 shows another application of this clutch, this time in the center of a four-step cone pulley, where the operation is very plain. The clutch lever also carries

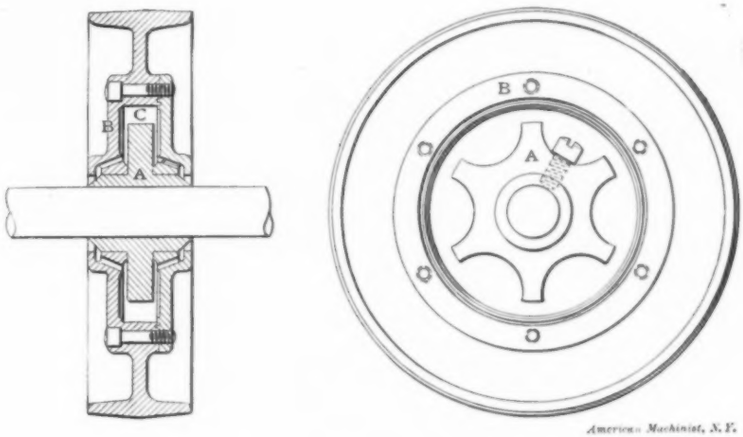



FIG. 5. A NOVEL LOOSE PULLEY

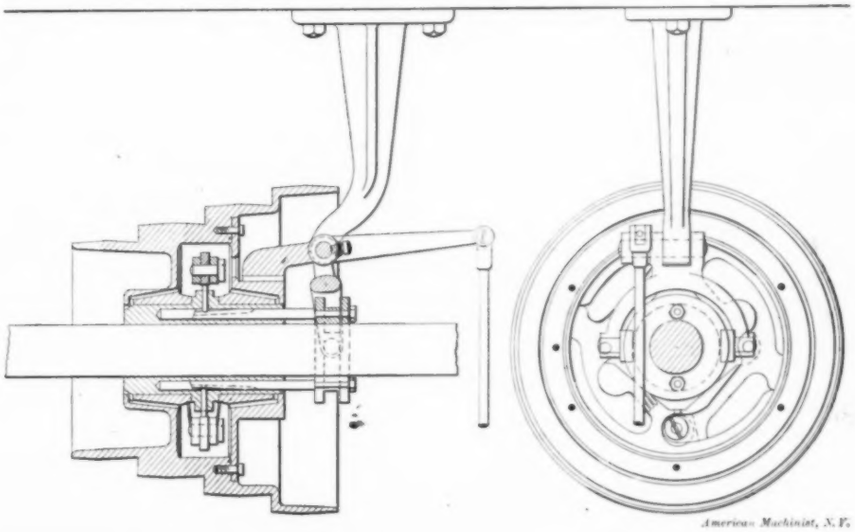



FIG. 4. FRICTION CONE DRIVE FROM MAIN LINE SHAFT

a brake shoe, which is applied as soon as the clutch is thrown out of action and remains operative until the clutch is again thrown in. This effectually prevents a machine being started against the operator's will and is an essential part of a system of this kind.

In Fig. 5 is a loose pulley of somewhat unusual construction in which the center casting *A* is fixed on the shaft either by key or set screw, the loose pulley revolving on this. The pulley is constructed with a large central chamber, as shown, and consists of the main portion *B*, which carries the rim and the cover plate *C*, which forms the other side of the bearing and also of the oil chamber around the central casting. When the pulley is running with the shaft and requires no lubrication, the oil is held against the outer wall of the chamber by centrifugal force, but as soon as the pulley stops and begins

running on the central bearing *A*, the oil is picked up by the wing of this central casting and runs down the sides of the chamber lubricating the bearings. Any oil which escapes at the end of the bearing will run down into the lower part of the oil chamber when the pulley is stationary, or be thrown into this same chamber by centrifugal force, if the pulley is running, in this way insuring constant lubrication and also reducing to a minimum the waste of oil from the end of the bearings.

## A Novel Core Oven

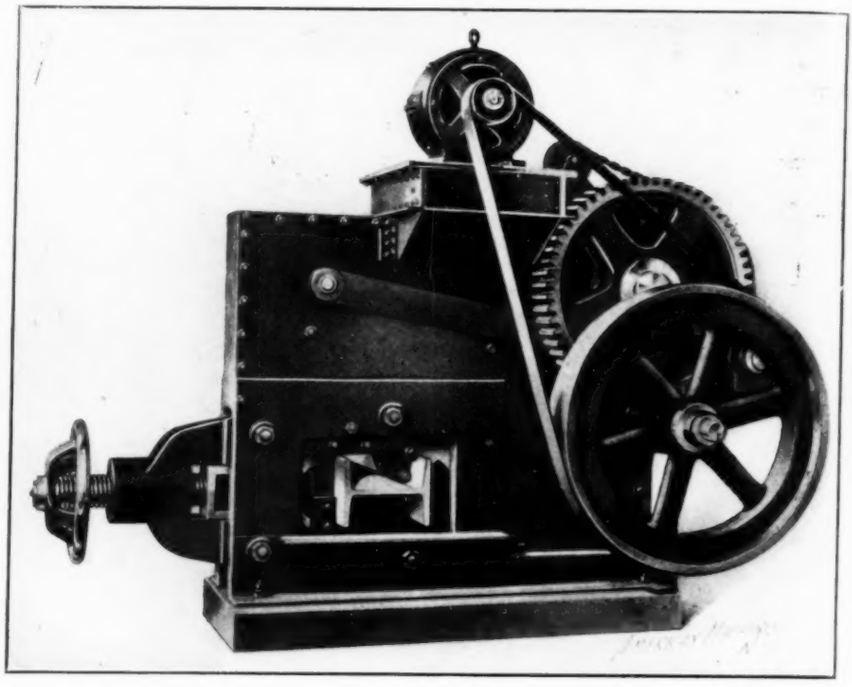
This core oven has been designed to give a large capacity within a small space by making the baking process almost continuous and at the same time wasting as little heat as possible.

Fig. 1 gives a general view of the construction, while Fig. 2 shows a cross-section by which the operation is made clear. The trays for supporting the cores are twice as long as the depth or width of the core oven, and a vertical partition in the middle of the tray acts as a door to prevent the escape of heat when the tray is in either of its extreme positions. The opposite side is closed by the regular swinging door in either case.

The projecting portions of the trays are filled with green cores and then pushed into the oven, the partition forming the door on the far side and the swinging door closing the front. While these are baking, the other half of the tray can be loaded with a new batch of cores which are drawn into the oven and commence baking as soon as the first lot are removed. This avoids all loss of time and reduces the escape of heat to a minimum. Heat is supplied by a coal fire at the bottom, as in the usual way, although oil or gas can be readily used if desired. This is the invention of Joseph J. Johnson, 327 Sussex avenue, Newark, N. J.

## "S. & N." Beam Shear

The halftone illustrates this shear clearly. It has a capacity for standard I-beams 7- to 20-inch, 80 pounds; Bethlehem "B" sections up to 18-inch, and with special tools "B20" and "B20a;" channels



BEAM SHEAR

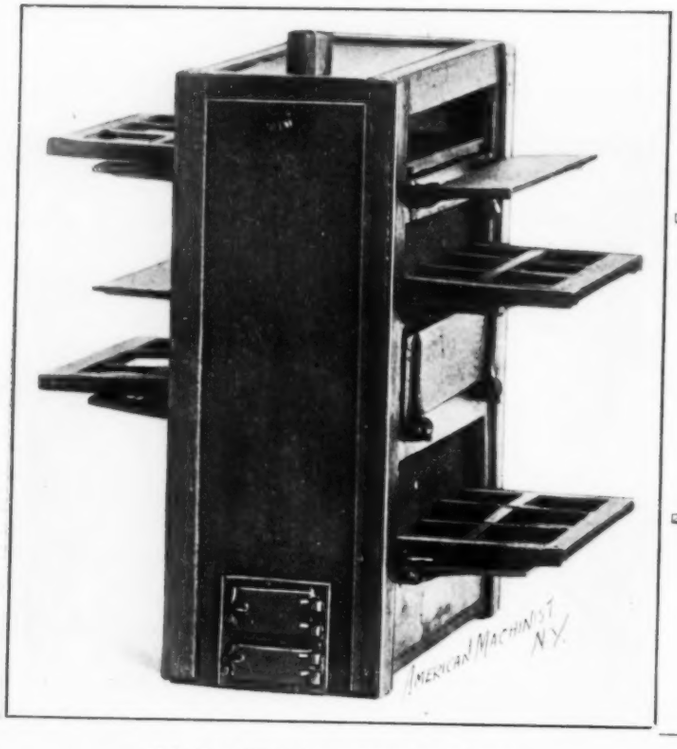



FIG. 1. A VERY CONVENIENT CORE OVEN

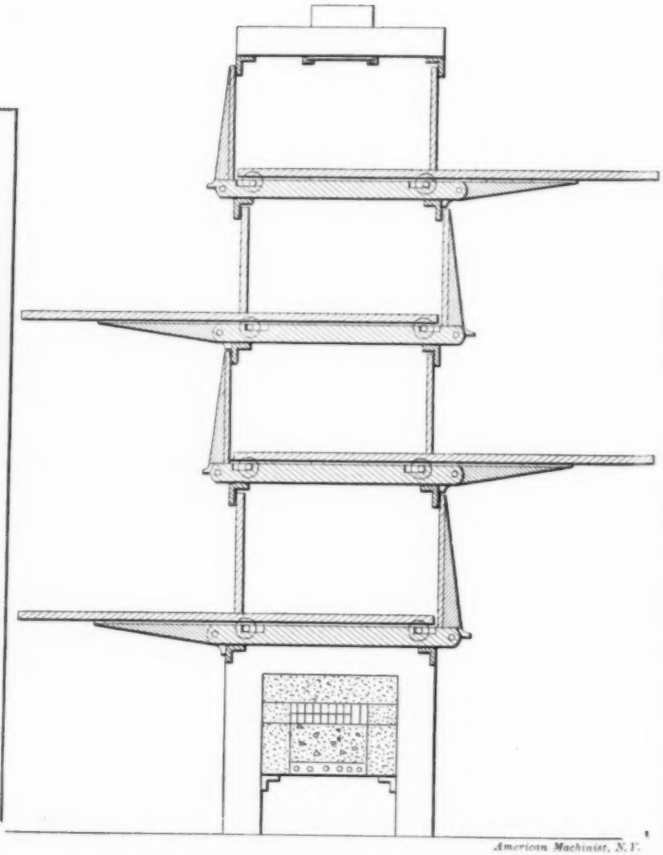


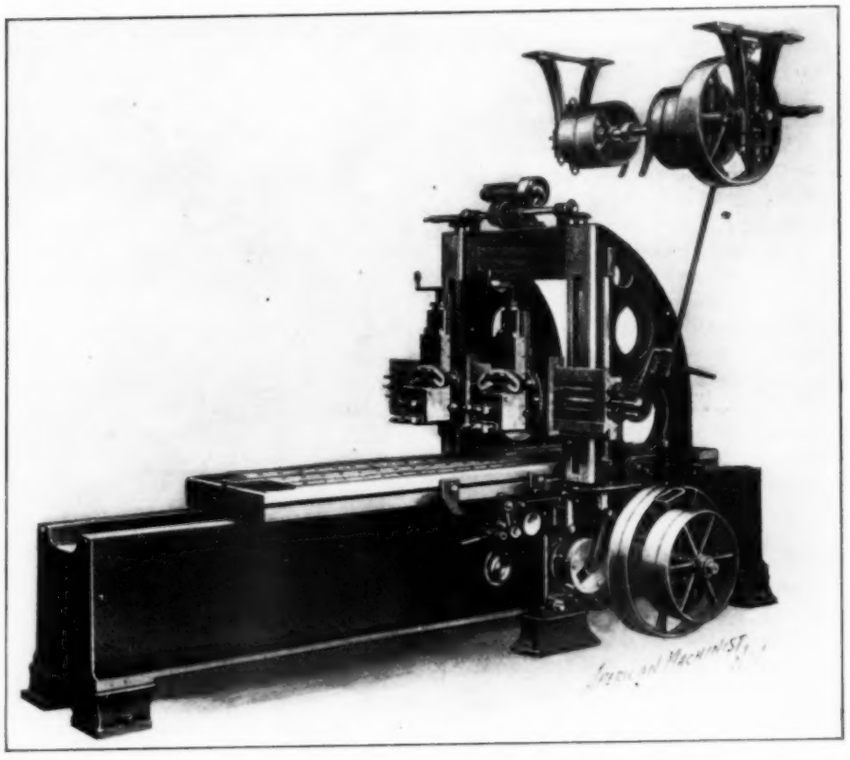

FIG. 2. CROSS-SECTION OF CORE OVEN

up to 15-inch, and angles up to 6x6x¾-inch. The machine requires 20 horsepower for its maximum capacity, making a cut in 15 to 25 seconds. The weight of the machine is 20,000 pounds. Its length is 12 feet; width, 4 feet, and hight, 9 feet. The frame consists of two steel plates, the thickness of which is 1⅛ inches after machining. Around the opening the frame is reinforced to 2⅜ inches. The gears are of cast steel, and have cut teeth. The operation of the machine is simple. The upper knife penetrates the beam to be cut from the outside and goes through rapidly. No handling is required after the beam has been placed upon the knives. These beam shears are built by Schulze & Naumann, Coethen, Germany; their American representative being the Wiener Machinery Company, 50 Church street, New York City.

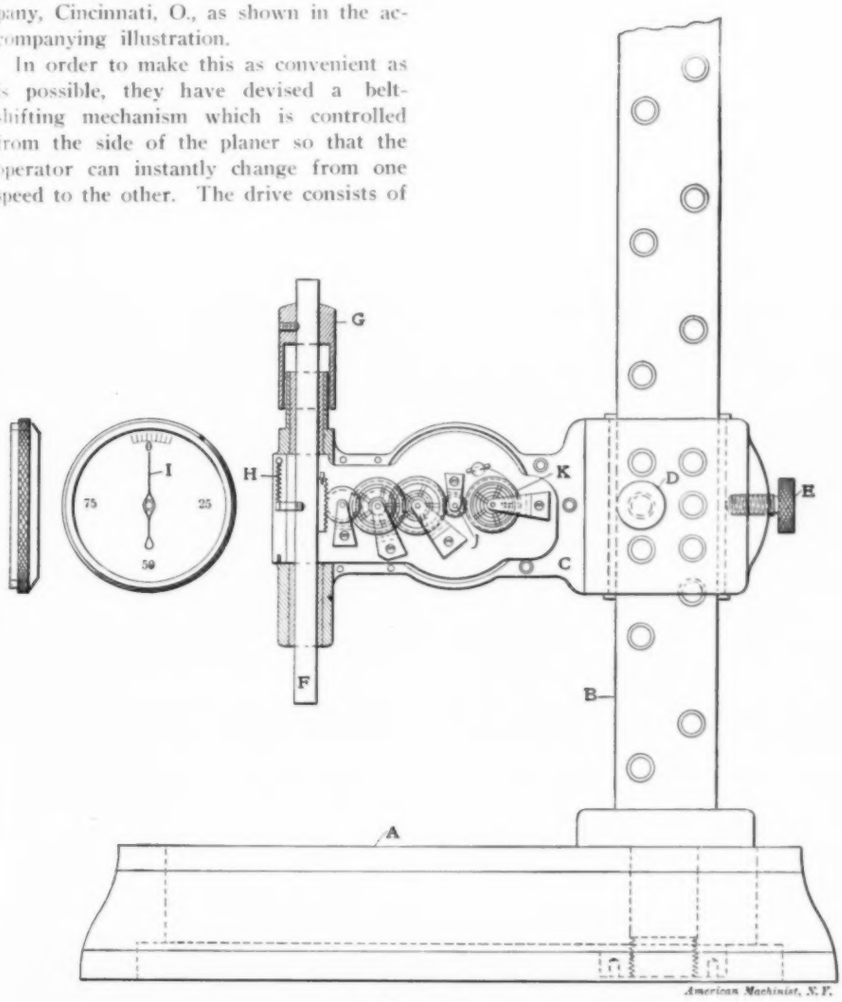
## Two Speed Planer Drive

That there is a real demand for more than one speed on planers is shown by the various multi-speed planer drives now being built. One of the simplest methods of securing two speeds is the use of the two-speed countershaft and this has been adopted by the Cincinnati Planer Company, Cincinnati, O., as shown in the accompanying illustration.

In order to make this as convenient as is possible, they have devised a belt-shifting mechanism which is controlled from the side of the planer so that the operator can instantly change from one speed to the other. The drive consists of two sets of pulleys, one keyed to the shaft and the other a wide-faced pulley running loose on it. These are driven by independent belts from the line shaft running at any speed desired to give the required cutting speed. In addition to this they use the extra-heavy return pulley and the cutting pulley, both keyed to the shaft and adjoining the wide-faced pulley. By moving the operating lever in one direction, the high-speed belt is moved on to the cutting pulley, while the low speed is secured by moving it in the opposite direction. The return belt remains in one position, giving a constant return speed. It has been designed especially for use on their smaller planers from 22 to 36 inches, inclusive.



CINCINNATI TWO-SPEED PLANER DRIVE




HIGHT GAGE

## Hight Gage

This instrument is designed to provide means whereby the distance between a stationary base or a known surface and a given point may be accurately determined. The gage has a base *A* supporting a standard *B*, which carries an arm *C*, the outer end of which carries the gage mechanism. The base is provided with a longitudinal slot, and standard *B* can be adjusted to any desired point on the base and securely clamped by the lock nut at the lower end of the standard. The standard proper and the arm *C* are provided with a number of bushed holes arranged in two parallel lines, and the arm carries a hardened pin *D* by which it may be fixed at different hights on the standard. When located

the screw *E* serves to clamp the arm fast in place. The outer end of the arm forms a sleeve in which are fixed two hardened and lapped bushings for supporting the vertical rod *F*. A collar *G* is attached to the upper end of the rod to facilitate lifting it by the fingers and a spring *H* is attached at the front to partly support the rod and permit it to rest lightly against the object being measured, irrespective of the weight of the rod and collar. The pointer *I* is mounted on an arbor *J* in the case formed in arm *C*, and the gear tram shown connects this arbor with a short rack attached to rod *F*, so that motion on the part of the latter is transmitted to the indicator pointer, which swings over graduations on a dial reading to thousandths of an inch. A gear wheel *K* provided with a light coil spring tends to rotate the pointer and all the gears in one direction; that is, the spring takes up the back lash or lost motion, although not producing any movement on the rod *F*.

In using this gage, the object to be measured is placed on the base and the arm *C* adjusted to such a position that the lower end of the rod *F* will be at the nearest ½ inch below the total hight of the object. The gage dial is then rotated to bring the zero line directly beneath the pointer, the rod *F* raised by the nurled thimble *G*, and the object to be measured placed beneath. Rod *F* is then allowed to descend until it just touches the piece to be measured, and the extent to which the pointer rotates may be read on a dial. This, taken in addition to the particular point on the standard *B*, to which the arm *C* is adjusted, will give the total hight of the work. The patentee of this gage is Louis Mastrangal, 35 Spring street, West Hoboken, N. J.

---

To those who have wondered at the record-breaking production in the automobile industry in the face of recent depressed conditions generally, and entertained doubts as to the possibility of continued capacity output in this line of trade, figures furnished by the American Motor Car Manufacturers' Association will have a tendency to dispel such doubts for the immediate future at least. From reliable estimates 70,000 cars will be put out in the year 1909, and the association, according to plans that can reasonably be expected to materialize, places the output for 1910 at the colossal figure of 200,000 cars. This high figure is not merely visionary either for it is based upon the result of carefully compiled reports from 80 of the leading automobile builders in the country. Thirty thousand cars is down for the largest single factory output, while there are several ranging from 10,000 to 25,000 machines, and dozens of manufacturers promising from 1000 to 8000 cars for what promises to be the banner year in the history of automobile manufacture in this country.

# Trade Opportunities in Australia and Tasmania

By M. de Moreira

The value of the imports of Australia for last year was $239,835,704, being a decrease of $9,898,461, as compared with the previous year. The exports amounted to $313,592,394, showing also a decrease of $40,552,445. From whatever standpoint one may examine the imports and exports of Australia it would be difficult, however, to arrive at any other conclusion than that country is at the present time in a very prosperous condition, the excess of exports over imports leaving a handsome surplus. The character and volume of the exports, chiefly the product of primary industries, are significant of the existence in Australia of a large and well equipped farming population. There are, nevertheless, a good many other opportunities for American manufacturers of machinery.

## Railways

The railways, it must be said, employ only English machinery, but here and there some American machine tool is seen; the trouble is that once sold, the manufacturer seems to forget entirely about his Australian client, and apparently waits for the purchaser to remind him of his existence.

The Australian railways have more different gages than are found in any other country, there being at present five. These lead to infinite difficulties in interstate traffic and there is no immediate prospect of a definite change; the question is a very serious one for the American manufacturer who has to ship his goods to Australia and one which obliges him to pay strict attention to the instructions given by the purchaser.

## Harbor Improvement

To facilitate shipping the Australians have begun a certain work necessitating machinery which could be furnished from here. I refer to the dredging work which is being done at the entrance to the Australian port of Newcastle in order to augment the depth of that harbor. This increased depth of water has been brought about by the adoption of a suggestion made to the Public Works Committee when the plan of improvements at the entrance of the Clarence river was under discussion. One of the engineers said that the present breakwater was of very little benefit and did not deepen the entrance and suggested that a sand pit be dug at the end of the northern breakwater, and that if that were done the depth at the entrance would be increased.

That experiment had been tried at Durham and had been crowned with success. It had been found that the large hole scooped out had acted as a pit for the sand coming around the northern breakwater, and by this means the entrance had been kept clear.

The American dredges are a little better than the English, and I feel sure that the Australians, though English colonists, would prefer them.

## Mining

A large deposit of manganese has been discovered in the state of Victoria; the beds are now being opened up, and the report is that the ore is of very good quality. The lode is seven miles in length, 396 feet wide, and has been proved to a depth of 70 feet, at which depth it is said to carry over 80 per cent. of dioxide of manganese.

The state of Victoria has also gold mines, of which the output is augmenting every year. English mining machinery is not provided with such uptodate labor-saving and ingenious devices as that made in the United States and American manufacturers of mining machinery have an excellent opportunity there. I do not, however, mean to speak disparagingly of English mining machinery, which is very good, England having for many years furnished mining machinery for every mining country, but I claim that we have machinery which can more than compete with the English make.

Coal-mining machinery made in this country has not much chance of being bought for Australian coal-mining work; still there is a certain demand and it would be well for our manufacturers to make some efforts to sell more of their coal-mining machinery than they are doing now.

High customs duties have been the cause of the erection of a large piano factory in the state of Victoria. Piano making is not new in Australia, as similar instruments, though in small quantities, have been manufactured in South Wales. This factory, however, will be better equipped, and is intended to turn out 2000 pianos a year. In the equipment of such a factory, the United States could certainly compete with England, if not with France and Germany.

## Tasmania

South of Australia, facing the southern shores of Victoria, is Tasmania, where there exist great opportunities for American manufacturers of woodworking machinery, as the woodworking industry of Tasmania is quite important, although most of the machinery used is out of date.

The most important reason why American-made woodworking machinery would find an easy sale in Tasmania lies in its labor-saving features. It is very difficult in Tasmania to obtain good labor, and American machinery which would, in a measure, obviate this difficulty, would be more than appreciated by the Tasmanians.

It is well, however, to remind the American manufacturer of the exception-

ally hard wood of Tasmania, and that, therefore, a heavier class of machinery should be sold than that used for the softer woods of this country. Tasmania is very rich in timber resources of many kinds, especially blue gum, blackwood and myrtle.

Another lumber which is used very much there and which lately has been employed for carriage building is the crow's-foot elm, which takes the place of our hickory. There are two varieties: the dark and the light. The wood of the dark is very beautiful when cut in the radial direction, being of a light ground mottled with flakes of bright brown. It is very elastic and used mostly for carriage woodware and for spokes. The light wood is preferred on account of its resemblance to hickory. As I have said, this wood is very strong; it has been tested at the physical laboratory at Melbourne University, with superior results.

There are numerous sawmills in Tasmania, the largest being located in Launceston, and noted for the use of enormous

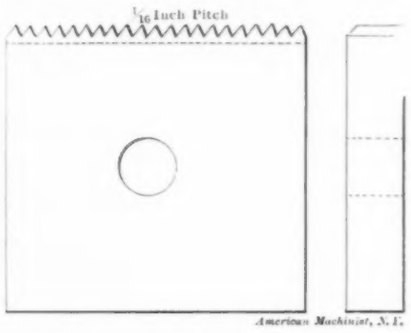



FIG. 1. CUTTER FOR SERRATING BRAKE DRUMS

band saws. Other sawmills of importance are those at Port Esperance and at Port Huron.

From these sawmills light tramways or railways run back into the forest where the trees are felled. Considerable skill is needed to transport the logs to the tramway or railway, which conveys them to the mill. The most uptodate appliance is a portable steam winch, kept in position by being chained to a tree stump by a wire rope. A "shoe," in shape like the bowl of a spoon, is fixed under the front end of the log, and by the use of snatch blocks, affixed to convenient trees, the winch is enabled to haul at various angles.

Australia, as I said before, is essentially an agricultural country and numerous kinds of agricultural machinery ought to sell easily there. A few other industries exist, nevertheless, such as the manufacture of hats, clothing, brushes, matches, etc.

All told, there is a good trade to be obtained there for American manufacturers, and, providing they are careful to follow closely the instructions of the purchaser, they will find no regret in catering to that part of the world.

Credit is necessary, however, but unlike South America, it is very easy to find the rating of the buyer, and little trouble is to be anticipated in that direction.

## Two Awkward Lathe Jobs

By F. J. Town

The first of these was to turn a finely serrated surface on the faces of four cast-iron brake drums, belonging to the paying-out gear of a cable ship. As the ship was home for only a few days, it was a hurry-up job. The drums were 10 feet in diameter with a 10-inch face to be serrated. The trouble that turned up was this. The metal was rather stiff, and the slowest speed of the lathe a bit too high, with the result that the tool, as shown in Fig. 1, would stand up for only a few minutes. There was no time to alter the drive of the lathe, for half hours, even, were of consequence.

The remedy was to impel a cold-air blast directly on the cutting tooth of the cutter. The blast had the double effect of blowing the hot chips away from the tool, and also extracting the heat developed in cutting. Being under considerable pressure, the cold air made its way to the points of the serrators; the particular places required.

With this application of air the tool lasted an hour, and as two tools were made, one could be repaired and hardened, while the other was in use. The same method has been used since, with considerable success.

The second job was to bore a ten-ton roll, the core of which had been badly distorted and displaced when casting. In Fig. 2 will be seen the form of the cast hole, and the difficulty of boring it out will be easily recognized. It is obvious that no regular boring tool could be used, as the lump of metal at *B* extended beyond the center line.

The job was sent into the shop to be done on the horizontal borer, but it was impossible to get a boring bar through the hole. The job was done as shown in the sketch. The roll was then rigged up in a lathe that was three feet between centers and with ample driving power. The tool bar, shown to the left of Fig. 2, was held in the tool rest and prevented from turning by a flat at the bottom, and it was fed up with the loose headstock. The drill-shaped part cut away the metal beyond the center; the toothed size of the flat cutter preceded the flat side and broke the metal up and equally distributed the work between both sides of the flat cutter.

The guide collar was turned 1/32 inch less than the diameter of the cutter, and followed the bored hole to prevent the cutter from being forced away from the heavy cutting side, and yet was not too tight in the hole, so as to join. The cutter went through as straight as a gun-barrel in 20 hours, and it looked good enough to bore a dozen more.

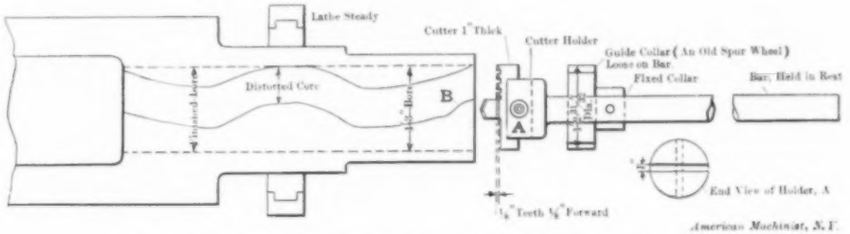



FIG. 2. PART OF ROLL WITH CROOKED HOLE AND TOOL FOR BORING

## Roderick Perry Curtis

Roderick Perry Curtis, president of The Curtis & Curtis Company, Bridgeport, Conn., died on August 9, as the result of injuries received in an automobile accident several weeks before.

Mr. Curtis was a native of New York, born in 1860, although he has lived in Connecticut since he was about eight years old. His first business venture was in 1882, when with William D. Forbes, the firm of Forbes & Curtis was founded to manufacture the Forbes patent die stock. Five years later Mr. Forbes' interest in the business was taken over by Lewis B. Curtis, and the firm of Curtis & Curtis was formed, which has been continued since, having been incorporated in 1900 under the name of The Curtis & Curtis Company, with Roderick Perry Curtis as president and secretary.

In late years his interests had become varied, Mr. Curtis being a director of several manufacturing corporations, and he was also a prominent figure in the social circles of Bridgeport.

For eight nights during the Hudson-Fulton celebration this fall, New York will be the most brilliantly lighted city in the world, according to the plans of the Hudson-Fulton Celebration Commission. The illumination will begin at 6:30 nightly, and continue until 12:30 a.m. Estimates place the number of lights to be used, in addition to the regular lighting, at between 1,000,000 and 1,500,000 incandescent, 7000 arc lights, 3000 flare arcs, one battery of four searchlights of 100,000 candlepower each, and one battery of 12 searchlights, aggregating 1,700,000 candlepower.

## Difficulties of Hardening Steel by Color

That the carbon content of steel has an influence on the colors when hardening and tempering them is shown by some pieces of carbonized steel which were given different heat treatments by the American Metal Treatment Company, Elizabeth, N. J. These pieces are shown in the accompanying halftone, and it is to be regretted that the colors cannot be shown, although the contrast between the low-carbon center and the high-carbon outer shell can be seen. Some of these pieces were left rough, as they were broken, and others were ground and polished before hardening.

The pieces *A* and *B* are ½x1¾ inches, and *A* is untreated, while *B* was hardened and then drawn until the high-carbon outer shell was a greenish-blue color. The difference between the two colors showed a decided contract.

The pieces *C* and *D* were ground and polished and then hardened and drawn until the outer shell was a dark blue. This left the low-carbon center a dark brown. These pieces were ¾ inch diameter.

The piece *E* was 1 inch square, and it was hardened and not drawn. This left the high-carbon shell a bright steel color, while the low-carbon center was almost a black. The 15/16-inch square piece *F* was drawn to a dark blue after hardening, and this left the low-carbon center a dark brown, similar to the pieces *C* and *D*.

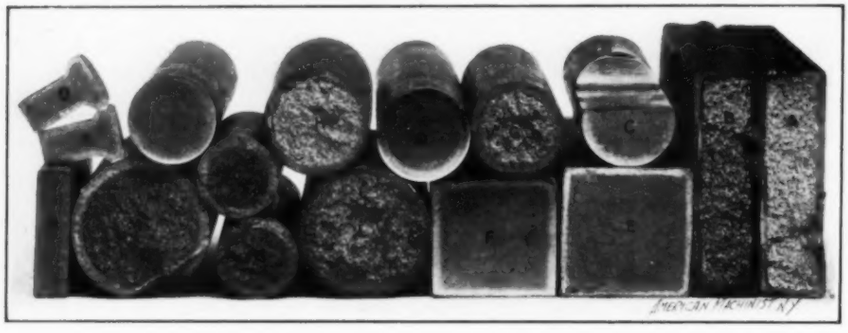
The piece marked *G* was hardened and drawn to a purple, and this left the center a yellow brown or dark straw color. The piece marked *H* was hardened and drawn until the high-carbon outer shell was dark brown, and this left the low-carbon center a light straw color.

The pieces marked *L* and *M* are 1 inch in diameter. *L* was hardened and drawn until the outer shell was a full purple, and this left the low-carbon center a spotted red brown. Piece *M* was hardened and drawn until the outer shell was a full blue, and this left the center a brown purple.

Pieces *J* and *K* are ⅝ inch diameter. Piece *J* was hardened and drawn to a dark blue, which left the center a dark brown, while piece *K* was hardened and drawn to a purplish blue, and this left the center a light brown.

Pieces *I*, *N*, *P* and *O* were drawn to a dark blue on the high-carbon outer shell, and this left the low-carbon center a dark brown.

While the hardening of steel by colors has been successfully done in the past, and will be done many times in the future, these pieces would indicate that it was necessary to know the steel that was being hardened before one would be capable of getting the proper temper by colors. They would also indicate that the carbon content has an effect on the color. Many other ingredients, that are being added to steel at the present time, are also liable to influence the color which steel takes at a given temperature. The results obtained from these pieces seem to make it imperative for the hardener to test a sample piece from each lot of steel before attempting to harden it by color.



CARBONIZED STEEL AFTER BEING HARDENED AND DRAWN TO COLOR

## Hardening Flat Steel

By T. Robson Charlton

The other day I had some pieces of high-speed steel ¼x1x8 inches, that required hardening. They came back from the toolsmith considerably warped so I took them down myself to see the thing done and I noticed as they were losing their heat in the blast, they commenced curling again. I drew the toolsmith's attention to this circumstance and he tried a kink I have not seen before.

Putting the strip back in the fire he heated it to the usual hardening temperature and on taking it out of the fire he rubbed each side with a piece of common yellow soap, and then placed the strip in the blast.

This trick was successful, both with pieces hardened in the blast and those hardened in oil.

## Forthcoming Meetings

International Association for Testing Materials, fifth congress, Copenhagen, Denmark, September 7-11.

International Association of Machinists, biennial convention in September, Denver, Colo.

Brotherhood of Railway Carmen, biennial convention in September, Atlanta, Ga.

National Machine Tool Builders' Association, fall meeting, October 12 and 13, New York City. P. E. Montanus, secretary, Springfield, Ohio.

## Business Items

The business of Edgar Allen & Co., Ltd., manufacturers of Allen's tool steel, will in future be conducted under its own name at 23 West Randolph street, Chicago, and 282 Pearl street, New York.

The Western Electric Company reports that its greatest gain in sales during the last seven months has been in the Central West and Pacific Coast sections. On the basis of seven months' returns the company is operating at the rate of forty-six million per annum or 38 per cent. ahead of the same period last year—June returns 35 per cent. ahead of June, 1908.

## Business Opportunities

Otto Thum, Grand Rapids, will erect a large garage.

The Holland (Mich.) Shoe Company will build an addition.

The Berlin (Wis.) Pail Company is building an addition.

C. J. Nelson is erecting a foundry at North Milwaukee, Wis.

The Escanaba Extract Company, Wells, Mich., will erect a plant.

The Merrill (Wis.) Iron Works was partly destroyed by fire.

The Clare (Mich.) Knitting Mills will be moved to Saginaw.

The Detroit (Mich.) Concrete Pipe Company will erect a factory.

The King Paper Company, Kalamazoo, Mich., will erect a new mill.

The Buhl Malleable Company, Detroit, Mich., will erect a new plant.

The Central Foundry Company, Anniston, Ala., will enlarge its foundry.

Lewis Hill, president of the Sparta (Wis.) bank, will erect a garage.

The Bonner Wrench Company, Chrisman, Ill., will enlarge its plant.

The Model Automobile Company, Peru, Ind., is erecting a new factory.

Fairbanks, Morse & Co. will erect additions to the plant at Beloit, Wis.

The Lyons Boiler Company, De Pere, Wis., will build an addition to its plant.

The Pequonnock Foundry Company, Danbury, Conn., will erect a new plant.

The U. S. Glue Works, Carrollville, Wis., is building an addition to its plant.

The Josephine Furnace, Josephine, Penn., is building a new blacksmith shop.

The Hagemeister Brewing Company, Green Bay, Wis., will erect an addition.

The Champion Motor Car Company, Milwaukee, Wis., will erect a garage.

The Celford Tool Works, Buchanan, Mich., will erect an addition to its plant.

The Asbestos-Protected Metal Company, Canton, Mass., will erect an addition.

The Grendel Mills, Greenwood, S. C., is to erect a new mill to cost $500,000.

The Wisconsin Furniture Company, Milwaukee, Wis., will erect a new plant.

The Bay City (Mich.) Swing and Ladder Company is erecting a new factory.

The De Pree Chemical Company, Holland, Mich., will build a $10,000 addition.

The National Candy Company, Grand Rapids, Mich., will erect a four-story factory.

The Mandt Wagon Company, Stoughton, Wis., will erect a foundry, power house, etc.

The Brighton Mills, Passaic, N. J., will erect a three-story addition to cost $45,000.

The Wright Carriage Body Company, Moline, Ill., is building an addition to its plant.

Scott & Bowne, New York, chemists, are erecting a factory at Watsessing, N. J.

W. H. Read, 396 Third avenue, Troy, N. Y., will erect a machine shop in Upper Troy.

The National Wood Pipe Company, Portland, Ore., will erect a new $400,000 plant.

The Merrill (Wis.) Railway and Light Company will spend $25,000 in improvements.

The Delaware Leather Company, Wilmington, Del., will build an addition to its plant.

The Rochester (N. Y.) Can Company has taken out a permit to erect a new factory building.

The P. Derby & Co., New York, chair manufacturers, will build a factory in Jersey City.

The Visel & Conover Novelty Company, Bronson, Mich., will erect a two-story factory.

The Patton Sash, Door and Blind Company, Rome, Ga., will build an addition to its plant.

The Dean & Berry Paint Company, Columbus, Ohio, is having plans drawn for a new factory.

The Root & Van Dervoort Engine Company, Moline, Ill., is erecting an additional building.

The Springfield (Mass.) Street Railway Company is preparing plans for a new repair shop.

A new roundhouse is to be built at Havana, Ill., by the Chicago, Peoria & St. Louis railway.

The Badger State Tannery Company, Sheboygan, Wis., will erect an addition to its plant.

The Warren Featherbone Company, Three Oaks, Mich., is erecting an addition to its plant.

The Advance Grease and Chemical Company, Jackson, Mich., will erect a three-story factory.

O. L. David, Meridian, Miss., will erect a plant for the manufacture of wagons and buggies.

The Jones Paper Box Company, of Newark, Ohio, will establish a branch factory in Columbus.

The Maine Screen and Ventilator Company, Portland, Me., has bought a site for a new plant.

The Minneapolis Lumber and Cedar Company, Rhinelander, Wis., will enlarge its mill at Gagen, Wis.

The Minetto-Meriden Shade Cloth Company, Minetto, N. Y., intends erecting a large cotton mill.

The Wiscassett Mills Company, Albermarle, N. C., has started the erection of new cotton mills.

The Orwigsburg (Penn.) Knitting Company will erect an additional building and double output.

The Scott & Howe Lumber Company, Ironwood, Mich., will rebuild their mill, recently burned.

Mueller & Stock, Grand Rapids, Mich., furniture manufacturers, will erect a four-story factory.

The Columbus (Ohio) Heating and Ventilating Company has taken out a permit for a new factory.

The American Pad and Paper Company, Holyoke, Mass., will build a $20,000 addition to plant.

The Kingman-Moore Implement Company, Oklahoma City, will erect a four-story factory building.

Crane & Breed Manufacturing Company, Cincinnati, Ohio, carriage makers, are building an addition.

The plant of the American Fork and Hoe Company, at Willoughby, O., will be moved to Jackson, Mich.

The Badger Motor Car Company, Columbus, Wis., will erect a plant for the manufacture of motor cars.

Kissell & Sons, Hartford, Wis., will erect an additional building for the manufacture of motor cars.

It is reported the Southern Iron and Steel Company, Gadsden, Ala., plans to build another iron furnace.

The Brodesser Elevator Company, Milwaukee, Wis., is planning to establish a branch plant in Winnipeg.

The Reliable Shoe Company, Orwigsburg, Penn., has remodeled its building and will install motor power.

The Pilliod Company, Swanton, Ohio, manufacturing valves, etc., will probably locate in Toledo, Ohio.

Florence Villa (Fla.) Fruit Growers' Association has awarded a contract for the construction of a packing plant.

The Carman Manufacturing Company, Tacoma, Wash., furniture makers, will erect a new four-story building.

The plant of the Niagara Pulp Board Company, Niagara Falls, N. Y., destroyed by fire, is to be rebuilt.

Jacob Johannes, St. Paul, Ind., carriage manufacturer, will engage in the manufacture of automobiles.

The plant of the American Hardware Company, Ottawa, Ill., was burned, causing a loss of over $75,000.

Foster Bros. Manufacturing Company, St. Louis, Mo., making bed springs, is to erect another factory.

The Burlington Route is to build a new roundhouse at Toluca, Mont., to replace the one recently burned.

The Crompton & Knowles Loom Works, will erect an additional building at their plant in Providence, R. I.

The saw and shingle mill of the Peterboro (Ont.) Lumber Company was destroyed by fire. Loss, about $75,000.

The roundhouse of the Boston & Maine Railroad, at East Somerville, was destroyed by fire. Loss, about $25,000.

Fire caused a loss of $15,000 in the plant of the Menonimee-Marinette Paper Company, at Menominee, Mich.

The W. F. Norman Sheet Metal Manufacturing Company, Nevada, Mo., will erect an addition to its plant.

The Gardner (Mass.) General Foundry Company will build an additional foundry doubling its present capacity.

The American Vanadium Company is erecting a building to double the capacity of its plant at Bridgeville, Penn.

The lumber mill of the Chaleur Bay Company at Campbellton, N. B., was destroyed by fire. Loss, about $100,000.

The American Bag Company, Memphis, Tenn., is said to be contemplating the erection of a mill to make cotton cloth.

The sawmill of the Morgan Lumber Company at Lester, Wash., was destroyed by fire, causing a loss of about $35,000.

The canning factory of the Canadian Canners, Ltd., St. Catharines, Ont., has been destroyed by fire. Loss, $115,000.

N. H. Williams & Sons, Kalamazoo, Mich., will erect a three-story building for the manufacture of ice cream, etc.

The Phyne Bros. Lumber Company, Cartersville, Ga., will erect a plant for the manufacture of sash, doors, blinds, etc.

The Lautenbacher Candy Factory is being erected at Schuylkill Haven, Penn. Candy machinery will be installed.

The National Wire Cloth Company, Niles, Mich., has erected a new plant and is installing new engines and machinery.

The American Consulate at Durban, Natal, Africa, will be glad to receive catalogs to place on file for reference.

The Bishop & Babcock Company, Cleveland, Ohio, will enlarge its plant and install considerable woodworking machinery.

The Mount Vernon (Ill.) Car Company will build a $500,000 steel car plant in addition to the present wooden car plant.

The Atlantic Furniture and Lumber Company, Lineville, Ala., contemplates installing machinery for making excelsior.

The Boston & Albany railroad is preparing to rebuild the roundhouse at Palmer, Mass., which collapsed a short time ago.

Haggard & Marcussen, Chicago, Ill., manufacturers of metallic furniture, are having a new factory built to cost $75,000.

The Cinco Motor Car Company, Cincinnati, Ohio, is building a new six-story plant and will invest $200,000 in new machinery.

The Gillette Safety Razor Company, of Boston, Mass., has secured a site in Newark, N. J., on which a $200,000 plant is to be erected.

Andrew Johner, of Joplin, Mo., has secured a site in Muskogee, Okla., on which he will erect a cornice and sheet-metal factory.

The Kittanning (Penn.) Iron and Steel Manufacturing Company is enlarging its plant and will engage in the manufacture of steel.

Dickinson & Co., Eureka, Ill., will erect a new canning factory with 200-horsepower boiler capacity and 60-horsepower engine.

The Portland (Ind.) Foundry and Machine Company will erect a new plant, including a drop forging shop, foundry and machine shop.

The Pressed Steel Car Company of Pittsburg will build its new $2,500,000 plant at Chicago, instead of McKees Rocks, as originally planned.

The American Car and Foundry Company will erect a new car-erecting shop and steel underframe shop at a plant in Wilmington, Del.

Plans are said to have been prepared by the Pennsylvania Railroad Company for the erection of a large boiler shop at the Altoona, Penn., shops.

The W. E. Caldwell Company, Louisville, Ky., is erecting an addition to its plant for the manufacture of steel tanks and structural iron and steel.

The Minneapolis (Minn.) Motor and Truck Company, recently incorporated, is about to erect a factory for the manufacture of auto trucks.

The Watertown (Mass.) arsenal is in the market for an engine lathe, shaper, electric drill, shaft straightener and a hand pipe-threading machine.

The Peck-Hamre Manufacturing Company, Berlin, Wis., manufacturing mail boxes, will be in the market for some new tools, including a shaper.

The Frontier Boiler Manufacturing Company, Buffalo, N. Y., is in the market for a punch and shear, bending rolls, radial drill and an air compressor.

The Farmers Manufacturing Company, Suffolk, Va., will build a new plant and modern machinery for the manufacture of barrels, crates, etc., will be installed.

The Southern Railway Company is to establish a plant in Citico, Tenn., for the manufacture of switch frogs. D. W. Lum, Washington, D. C., is chief engineer.

The Standard Briquette Fuel Company, Kansas City, Mo., will erect a plant to consis

of three buildings, which, with machinery, will cost about $75,000.

Rohrer & Co., Orwigsburg, Penn., will erect a two-story addition to its shoe factory and install new machinery. They will also add an engine and boiler.

The Raleigh & Southport railway has purchased more land as a site for terminals, roundhouse, repair shop, etc. J. A. Mills, Raleigh, N. C., general manager.

Plans are being made for improvements at the plant of the Steel Car Forge Company at Newcastle, Penn., which will involve an expenditure of about $300,000.

The Schwartz Wheel Company, Philadelphia, Penn., has purchased a plant which will be altered and improved and equipped with modern machinery for the manufacture of automobile and heavy vehicle wheels.

It is reported the Job Iron and Steel Company, of Ashland, Ky., will erect a mill at Kenora, W. Va., for the manufacture of plain and corrugated siding and roofing.

The Granite Brick Company, Fremont, Neb., will rebuild its plant recently destroyed by fire. Brick machinery, boiler, engine, heater and pump will be needed.

The Sparks-Withington Company, Jackson, Mich., manufacturing roller bearings and pressed-steel metal products, will erect a new plant and double its present capacity.

The Republic Iron and Steel Company, of Pittsburg, Penn., has awarded a contract for the construction of a new steel tube plant at Hazleton, Ohio, to cost $1,500,000.

The High Wheel Auto Parts Company, Muncie, Ind., is building a plant for the manufacture of rear axles, jack shafts, steering devices for automobiles, high-wheel buggies, etc.

The Universal Stone Crusher Company, referred to as erecting a new factory at Cedar Rapids, Iowa, has been succeeded by the Eureka Stone and Ore Crusher Company.

The E. I. Du Pont de Nemours Powder Company, of Wilmington, Del., has bought a site near Aguilar, Colo., on which a plant will be erected. Several hundred men will be employed.

The Tennessee Coal, Iron and Railroad Company, of Birmingham, Ala., will install a new engine in its plate mill at Bessemer; also spike-machine, track-bolt machines and rivet machines.

Howe & Co., Louisville, Ky., brass founders, etc., have taken over the plant of the Howe Manufacturing Company and are overhauling the same. They will increase the force from 75 to 300 men.

The Puget Sound Iron and Steel Works, Tacoma, Wash., has secured permits for the erection of a new plant on the Puyallup river. This will include a foundry, forge shop, machine and pattern shop.

The American Dredge Company, which is now building a new plant at Fort Wayne, Ind., will need a lot of equipment, including boring and turning mills, lathes, shapers, grinders, hammers, forges, etc.

The Dodd Manufacturing Company, of Chicago, recently formed with $300,000 capital, is to locate a plant in Elyria, Ohio. The company will manufacture carpet sweepers. W. H. Thompson, of Elyria, is interested.

W. C. MacNabb Company, Chattanooga, Tenn., will erect a garage and repair shop and manufacture gasolene engines and small automobiles. The address is care of the Union Engineering Company, 815 Cherry street.

The A. P. Smith Manufacturing Company, of Newark, N. J., is to erect a new plant at Bloomfield, to consist of six buildings, including iron and brass foundry, machine shop, etc. The company manufactures tapping machinery, valve fittings, etc.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., September 9, for engine lathe, punching and shearing machine, boring and turning mill, hand pumps, saws, files, dies, lathe dogs, chaplets, grommets, water gages, belting, packing, etc., as per Circular No. 531.

A large steel plant will be established in Mexico City within the coming year by French and American capital. The initial outlay will be $50,000,000 Victor Belanger of Paris is the head of the concern. It is understood that a large part of the capital will come from Paris and Boston. Coal and iron mines in Mexico will be acquired later by the company.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., August 23, for air compressors, feed-water heater, grease extractor, hot water meters, revolution counters, gauges, ejectors, oil cups, cocks, gate valves, pipe and pipe fittings, anvils, chisels, stock dies, saw blades, grindstones, carborundum wheels, belting, magnesia pipe covering, etc., as per Circular No. 527.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: August 17—Pneumatic hose, carborundum wheels (schedule 1472); pipe and pipe fittings (schedule 1521, 1530); hacksaw blades, steel hammer die blocks, bolts (schedule 1523); screws (schedule 1529); August 24—Electric hoists (schedule 1513), portable forges, screws, steel, bronze wire (schedule 1498); universal milling machine (schedule 1514); August 31—Welding and cutting plant (schedule 1507).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: Aug. 24—Dump cars (schedule 1538), gasolene engine (schedule 1536), steel tubing (schedule 1541), dry batteries, graphite brushes, desk lamps (schedule 1537), motors (schedule 1542), sheet steel, copper, tin (schedule 1550), dies, cutters, hand taps (schedule 1542), drills, nuts, washers (schedule 1538), rivet sets (schedule 1551); Sept 13—Electrical air compressor (schedule 1554), pneumatic ash ejectors (schedule 1555), compressed-air locomotive (schedule 1554).

## New Incorporations

The Memphis Metallic Packing Company, Memphis, Tenn., has been incorporated with $15,000 capital. Incorporators, J. M. Rhodes, J. G. Kincaid, K. Trimble, etc.

The Safety Coupling-Pin Lifter Company, Lexington, Va., has been incorporated to manufacture a patent coupling pin. Incorporators, R. S. Bruce, J. M. Arthur, etc.

The American Jar Company, New York, has been incorporated to manufacture jars and bottles. Capital, $75,000. Incorporators, A. J. Powers, J. Snyder, E. F. Hoffman.

The Stevens-Sowers Motor Company, Boston, Mass., has been incorporated to manufacture motors. Capital, $12,000. President, Jas. W. Stevens, 18 Tremont street, Boston.

The Gilboa Electric Light and Power Company, Gilboa, N. Y., has been incorporated with $35,000 capital. Directors are E. S. Parsons, J. S. Case, of Gilboa, and others.

The National Anti-Friction Roller Bearing Company, Buffalo, N. Y., has been incorporated with $250,000 capital. Directors, Albert T. Killian, F. D. Tracy, 76 Johnson's Park.

The Cincinnati Steel Casting Company, Cincinnati, Ohio, has been incorporated to manufacture crucible steel castings. Capital, $50,000. Wm. Gilbert, 942 Kenyon avenue, president.

The Brookston Automobile Company, Brookston, Ind., has been incorporated to manufacture automobiles. The directors are Milton Gay, J. H. Kneale, W. C. Holstead, W. F. Frey.

The Atkinson Patent Water Wheel Company, Benton, Ark., has been incorporated to manufacture a patented water wheel. Incorporators, J. W. Atkinson, L. K. Mandlebaum, J. F. Lee, etc.

The Cleveland Collet and Machine Company, Cleveland, Ohio, is being organized by J. L. Holstein and others. Capital, $10,000. The firm will manufacture adjustable collets and small tools.

The Chicago Car and Equipment Company, Portland, Me., has been incorporated to manufacture locomotive engines and machinery. Capital, $500,000. President, Chas. E. Eaton, Portland.

The Freight Handling Machinery Company, Jersey City, N. J., incorporated to manufacture machinery, cableways, hoists, etc. Capital, $100,000. Incorporators, B. W. Tucker, R. D. Steel, etc.

The National Motor Supply Company, Toledo, Ohio, has been incorporated to manufacture motor supplies. Capital, $10,000. Incorporators, F. M. Chandler, V. H. Meyer, F. M. Fanning, etc.

The South End Machine Company, Akron, Ohio, has been incorporated. Capital, $10,000. A. A. Replogle, formerly connected with the Replogle Engineering Company, is one of the incorporators.

The Linkroum Automobile Company, Newark, N. J., has been incorporated to manufacture automobiles, motors, etc. Capital, $20,000. Incorporators, Courtland Linkroum, Wm. H. Linkroum, Chas. R. Erith.

The National Electric Specialty Company, Toledo, Ohio, has been incorporated to manufacture electrical supplies. Capital, $15,000. Incorporators, C. F. Wall, L. L. D. Chapman, E. B. Marshall and others.

The Bergen Auto Company, Rutherford, N. J., has been incorporated to manufacture motors, engines, engineering appliances, machine supplies. Capital, $50,000. Incorporators, E. Steffens, Jr., R. A. Gens, etc.

The Standard Steel Grain Door and Equipment Company, Wichita, Kan., has been incorporated with $100,000 capital to manufacture a steel grain door patented by E. B. Gilleland, general manager of the company.

The H. & H. Art Metal Manufacturing Company, Cleveland, Ohio, has been incorporated to manufacture ornamental and iron products. Capital, $15,000. Incorporators, John Hand, A. Hoselitz, Jacob Hammel, etc.

The Herzog Elevator Signals Company, Newark, N. J., has been incorporated to manufacture elevator signals and appliances. Capital, $500,000. Incorporators, F. B. Herzog, New York; E. C. Lum, C. W. Farie, Newark.

The Wordingham Manufacturing Company, Milwaukee, Wis., has been incorporated to manufacture patented automobile specialties. Capital, $50,000. Incorporators, W. G. Wordingham, Phil Kennedy, W. R. Greenlaw.

The International Burner Company, Brooklyn, N. Y., has been incorporated to manufacture machinery, tools and supplies, relating to gas, electricity or steam. Capital, $50,000. Incorporators, H. Neimann, A. J. Ibert, J. S. Averill.

The Automobile Rim Securities Company, New York, has been incorporated. Capital, $150,000. Incorporators, H. W. Goddard, R. H. Gay, New York; E. Week, Jersey City. The firm will manufacture automobile and vehicle parts.

The MacCracken-Hauer-Terry Company, New York, incorporated to manufacture power and excavating machinery. Capital, $15,000. Incorporators, Geo. C. MacCracken, 50 Church street; D. J. Hauer, 21 Park Row; O. K. Terry, 50 Church street.

The Tempo-Roll Music Company, New York, has been incorporated and will manufacture machinery for perforating and cutting music for musical instruments. Capital, $250,000.

Incorporators, W. R. Fielder, A. H. Reilly, F. J. Finn.

The Universal Supply and Manufacturing Company, Rutherford, N. J., incorporated to manufacture metal tops and covers, celluloid and fiberloid attachments and covers. Capital, $25,000. Incorporators, J. A. Turner, J. H. Cadwell, etc.

The Gussman Key Cutting Machine Company, North Pelham, N. Y., has been incorporated to manufacture key-cutting machines, etc. Capital, $30,000. Incorporators, W. J. Calhoun, M. J. Bernstein, Chas. Pierrez, all of No. 1 Madison avenue, New York.

The Trackless Trolley Company of America, New York, has been incorporated to manufacture automobiles, motor vehicles, etc. Capital, $150,000. Incorporators, Chas. E. Barrett, 242 Lenox avenue, New York; A. Livingston Norman, 24 Fiske Place, Brooklyn, etc.

## New Catalogs

Waltham Machine Works, Waltham, Mass. Pamphlet describing subpress die work. Illustrated.

Edge Moor Iron Company, Wilmington, Del. Catalog of boilers. Illustrated, 94 pages, 6x9 inches, cloth.

W. S. Rockwell Company, Bulletin No. 5, illustrating and describing muffle furnaces for assaying and other work.

Keuffel & Esser Company, 127 Fulton street, New York. Circular illustrating and describing K & E log duplex slide rules.

C. H. Wheeler Manufacturing Company, Philadelphia, Penn. Bulletin No. 10. Pumps. Illustrated, 32 pages, 3½x6 inches.

S. B. Stine, Osceola Mills, Penn. Bulletin A. Cars for coal, fire clay, ore and industrial railways. Illustrated, 7½x9 inches.

Butler Electric Company, 23 N. Broadway, Yonkers, N. Y. Folder, illustrating and describing electro-magnetic friction clutches.

The Trenton Iron Company, Trenton, N. J. Treatise on Bleichert System of Aerial Tramways. Illustrated, 64 pages, 5½x8 inches.

The Terry Steam Turbine Company, Hartford, Conn. Catalog 3, describing steam turbines. Illustrated, 16 pages, 6x9 inches, paper.

Schuchardt & Schutte, 90 West street, New York. Catalog describing tachometers and tachographs. Illustrated, 28 pages, 4x6½ inches, paper.

The Hill Clutch Company, Cleveland, Ohio. Booklet entitled, "A B C Engineering No. 1," devoted to line shaft bearings. Illustrated, 5x8 inches.

Trenton Engine Company, Trenton, N. J. Bulletin No. 7, describing compound- and single-cylinder steam engines. Illustrated, 22 pages, 6x9 inches.

Chain Belt Company, Milwaukee, Wis. General catalog No. 37 of elevating, conveying and concrete machinery. Illustrated, 304 pages, 6x9 inches, cloth.

The Berger Manufacturing Company, Canton, Ohio. Catalog describing steel filing devices and office equipment. Illustrated, 72 pages, 6x9 inches, paper.

The Young Machine and Tool Company, 149 Lafayette street, New York. Catalog describing lathes, punches and shears. Illustrated, 20 pages, 5x8 inches, paper.

Remington Tool and Machine Company, 50 Congress street, Boston, Mass. Circular illustrating and describing twist drill grinding gage, spring winder, surface gage.

American Oil and Supply Company, 52 Lafayette street, Newark, N. J. General catalog of supplies, tools and machinery for jewelers, silversmiths, tool makers, etc. Illustrated, 638 pages, 5½x8 inches cloth.

# Want Advertisements

*Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.*

## Miscellaneous Wants

Caliper catalog free. E. G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

We design and build light machinery, including fixtures, jigs, tools, punches and dies, and model work. The Matson Machine Co., Bethel, Vermont.

Metal specialties manufactured; models, dies and special machinery. Inventions perfected; correspondence solicited. W. E. Villinger, Williamsport, Pa.

Special machines for reducing the cost of production designed; inventions developed to a practical and commercial basis. Benj. Brownstein, mechanical engineer, Trenton, N. J.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

A large manufacturing organization wishes to sell one of its departments which makes a sheet metal engineering specialty not now in their line. Splendid opportunity for man with moderate capital to start business for himself, or for a manufacturer to add a profitable line. Box 490, AMERICAN MACHINIST.

Active Partner Wanted—Owner of plant located in large city in the Middle West, manufacturing hoisting machinery, brick-making machinery, pumps and other special lines, desires to withdraw from active business. Will sell all or part of his holdings to right man on very liberal terms. Box 491, AMER. MACH.

## Situations Wanted

*Classification indicates present address of advertiser, nothing else.*

CONNECTICUT

Superintendent, experienced in modern machine shop practice, a good organizer, cost reducer, desires change. Box 531, AMERICAN MACH.

ILLINOIS

Position wanted by an experienced superintendent, expert in machine work and manufacturing; a good organizer; resourceful in designs and processes for increasing production; location not material. Box 537, AM. MA.

MASSACHUSETTS

Superintendent, wide experience in manufacturing, desires change. Box 525, AM. MA.

Chief draftsman, mechanical engineer, first-class designer, good organizer and systematizer, desires executive position, preferably in the Middle West. Box 527, AMERICAN MACHINIST.

NEW JERSEY

Draftsman, technical graduate, six years' experience on general machinery and automobiles, desires change. "R. M.," Box 510, AMERICAN MACHINIST.

Position as foreman wanted; 12 years' experience as machinist, draftsman, foreman and factory manager; age 28; can produce the maximum at the minimum cost; manage male and female help to advantage; salary about $25. Address "J. G.," 936 Bloomfield St., Hoboken, N. J.

NEW YORK

Wanted—Position as chief draftsman or superintendent of manufacturing plant. Box 520, AMERICAN MACHINIST.

One experienced die maker, expert in one operation dies. Technical graduate and machinist, 18 years' experience. Box 521, AM. MA.

Superintendent desires change. Good mechanic, organizer and executive. Experienced in modern shop and foundry work. Box 523, AMERICAN MACHINIST.

Wanted—Position as assistant foreman in machine shop by energetic young machinist. Technical graduate; good jig designer. "E. M. S.," AMERICAN MACHINIST.

Technical graduate, 29, seven years' general experience in shop, foundry and drawing room, desires position connected with air compression or pumping machinery. Box 536, AMERICAN MACHINIST.

Designing engineer, high-grade automatic tools and machines; 17 years' experience, practical mechanic; graduate; can show records of successful accomplishments; any locality; $45 per week. Box 478, AMER. MACHINIST.

Technical and commercial manager and mechanical engineer, American, twenty years' wide experience, desires change; skilled in details of modern methods in office, sales, drafting room, shop, foundry, etc.; energetic, forceful, with quick comprehension; accustomed to heavy responsibilities and masses of detail; handled all departments of business of two millions annually; particularly posted on large and small gas and oil engines; highly endorsed; honest, able and loyal; seeks proposition from any desirable locality. Box 535, AMERICAN MACHINIST.

PENNSYLVANIA

Superintendent of wide experience with progressive concerns, would like to change. Box 518, AMERICAN MACHINIST.

Experienced machinery salesman now with prominent house, desires change; practical and selling experience covers period of fifteen years. Box 538, AMERICAN MACHINIST.

Wanted—Position as office manager by young married man 30 years of age. Have had 11 years' experience in handling order systems, stock room system and purchasing. Also experienced in cost systems, having been in direct charge of same for past few years. Box 526, AMERICAN MACHINIST.

## Help Wanted

*Classification indicates present address of advertiser, nothing else.*

COLORADO

An established company about to re-equip and greatly enlarge its plant, desires applications for the following positions: Factory superintendent, capable of taking entire charge of factory doing nothing but fine accurate work, but which must be done at minimum cost; general foreman, assistant to the superintendent; chief draftsman, preferably one with electrical experience; purchasing agent, cost clerk, shipping clerk, foreman for all machine parts departments; foreman for steel-pressing department; blacksmith foreman, who has had experience handling high-grade steels; foundry foreman, who can take entire charge of steel and iron foundry, and who understands the business thoroughly; cost estimator, who has had experience in all departments in this line. In sending applications kindly state fully and in detail all your qualifications, your specialties, if you have any, whom you have worked for, as well as whom you are working for now, salary expected, references and any other information which will help us in judging the merits of your application. The factory is located in one of America's most healthful and best locations and opportunities are limited only by employees' ability. Address Box 481, AMERICAN MACHINIST.

CONNECTICUT

Wanted—Traveling salesman to handle a lathe specialty as a side line. Box 737, Bridgeport, Conn.

INDIANA

Two experienced foremen for machine and assembling rooms, manufacturing gasolene motors. Give reference, experience and age. Box 262, AMERICAN MACHINIST.

Wanted—Machinery department foreman; must be familiar with latest machine-shop practice with ability to design jigs and tools for quick handling of duplicate parts. Model Gas Engine Works, Peru, Indiana.

Wanted—200 skilled workmen for manufacturing gasolene motors; new shop to be open about September 15; give experience and two references; state wages expected. The Western Motor Co., Marion, Indiana.

Wanted—An experienced foreman for machine department, one familiar with screw machines, drill presses, punch presses and milling machines for small accurate work; give reference and salary expected, to go out of city. Box 509, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—A draftsman and designer with fair working knowledge of the principles of refrigeration; one capable of making neat picture drawings. Box 528, AMERICAN MACHINIST.

Wanted—Assistant to head draftsman of manufacturing plant. One having had experience on automatic machinery preferred. State experience and wages expected. Box 532, AM. M.

Foundry foreman for up-to-date foundry employing 150 men. Will increase later. Produce engines and other standard lines. Want man experienced in coremaking, mixing by analysis, machine molding and modern methods. Give experience, references and pay expected. Box 494, AMERICAN MACHINIST.

MICHIGAN

Wanted—A few first-class toolmakers on small work; good wages and steady employment for competent men. Box 278, AM. MA.

Wanted—Thoroughly competent foreman to take charge of grinding department employing 25 hands; must be a strictly first-class man. Apply Buick Motor Company, Flint, Mich.

Wanted—25 first-class monitor hands and 12 assemblers. Apply by letter to "Superintendent," Detroit Lubricator Co., Detroit, U. S. A.

First-class toolmakers, machinists, turret lathe hands, milling machine hands, wanted; some capable of taking charge of departments. Must be A-1 men. Give age, experience, wages, etc. Apply Buick Motor Co., Flint, Mich.

Wanted—Engineer or machinist capable of laying out and designing motorcycles and of acting as master mechanic in a company now forming. Must be able to organize and direct men. Give references, experience and salary. Box 529, AMERICAN MACHINIST.

NEW JERSEY

Wanted—An experienced operator on Gridley and Cleveland automatic screw machines; a man capable of taking charge department preferred, a good position to the man who can make good. Address "Superintendent," Box 476, Newark, N. J.

Wanted—Draftsmen and detail men experienced in small gas-engine work. Give age, experience and salary expected. Box 496, AMERICAN MACHINIST.

NEW YORK

Tool and diemaker wanted by manufacturers of electrical specialties. State experience and salary expected. Edwards & Co., Inc., 140th street & Gerard avenue, Bronx.

Traveling salesman, to sell presses, etc.; reliable, resourceful and energetic man with good experience in sheet metal working. Please state experience in detail, age, etc. Niagara Machine & Tool Works, Buffalo, N. Y.

Wanted—Operator on Cleveland screw machines; also operator on Brown & Sharpe plain grinder. Apply by letter, stating experience and wages expected. Otis Elevator Co., Yonkers, N. Y.

Toolmakers wanted; first-class men experienced on jigs, fixtures and fine gages for close small work. State age, experience in detail, and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—A few experienced switchboard and mechanical draftsmen; steady employment. Apply in writing, Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—Foreman toolmaker, experienced in manufacture of iron valves preferred. State age, if now employed, married or single, and wages expected. Location Central New York. Box 533, AMERICAN MACHINIST.

Wanted—Man to take charge of machine shop near New York City, employing eight or ten men; must be a first-class all-around hustler, and willing to work himself. To a man who can fill the requirements there is a chance for advancement. Box 519, AM. MA.

Lathe, planer and boring mill hands wanted for day and night shift; no labor troubles, increasing force; applicants must state wages desired, past experience, if employed at present, and the names of past employers, to receive further consideration. Application considered confidentially. Apply Ingersoll-Rand Co., Painted Post, N. Y.

Superintendent wanted for large and modern printing-press factory. Must be first-class capable man with successful record in this line, able to estimate correctly, know how to handle men to best advantage, reduce costs, have thorough technical training and good mechanical and executive ability. Only men with the above qualifications need apply. Write fully, stating experience, age, references and salary. Box 506, AMERICAN MACHINIST.

OHIO

Wanted—Machinists accustomed to work on Corliss engines and pumping machinery. State age and experience; give references. The Heisler Company, St. Marys, Ohio.

Wanted—Thoroughly first-class machine-tool designer. Preference given to one now employed. State experience, where now employed, nationality, age, whether married or single and wages expected. All communications strictly confidential. Box 530, AMERICAN MACHINIST.

Wanted—Mechanical engineer; one who can take charge of drafting and designing machine tools. Must have extended experience along these lines. Must give recommendations and state former employers and salary received and wanted. Address "Machine Tool," AMERICAN MACHINIST.

Foreman—Man to take charge of tool-room work (20 men) which consists of general repairs, renewals, jigs and metal patterns, for large manufacturer medium line of heavy machinery. Must have held similar position of responsibility and be able to refer to results in former position. Apply by letter only, giving full details. Confidential. The Hill Clutch Co., Cleveland, Ohio.

Wanted—First-class machinists, lathe, planer, drill-press, screw-machine, boring and milling-machine operators, die-sinkers and pattern-makers who are seeking positions or desirous of improving on those which they have,—to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address "Commissioner's Office," No. 605 New England Bldg., Cleveland, O

PENNSYLVANIA

Machinists wanted. Lathe, boring mill and floor hands, air compressor work. The Blaisdell Machinery Co., Bradford, Pa.

Designer and draftsman on general machinery. A first-class designer capable of taking charge of work. Also one draftsman wanted. Box 447, AMERICAN MACHINIST.

Wanted—Graduate mechanical engineer having had some experience in practical machine design or teaching mechanical engineering, for instruction department of correspondence school. State age, experience and salary expected. Box 522, AMERICAN MACHINIST.

Wanted—General superintendent. A man with wide experience and up-to-date methods in general machine shop and foundry practice, to take charge of a shop employing about five hundred men, engaged in the building of heavy machinery. All correspondence will be treated strictly confidential. In writing give references, experience and age. Box 464, AM. MACH.

Wanted—A good live agent in every shop or factory in the U. S. to sell one of the best known preparations for removing grease and grime from the hands without injury to the skin. Absolutely guaranteed. An agent can make from $5.00 to $25.00 over and above his regular salary. This is no fake. Write for free sample and agents' terms. The Klenzola Co., Erie, Pa.

Wanted—A large machine tool manufacturer desires to employ an A-1 designer. Only such as have had experience on high grade work will be considered. To one who is competent, progressive and of good character an excellent opportunity is offered. State experience, salary expected and give references. All applications will be treated confidentially. Box 465, AMERICAN MACHINIST.

WISCONSIN

Superintendent for a growing machine-tool shop now employing about 125 men. Must be a good organizer, capable of speeding output without causing quality to suffer. Reply in detail as to experience, references and salary expected. Box 534, AMERICAN MACHINIST.

# For Sale

Purchaser for No. 2 Farwell milling machine, Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 508, AMERICAN MACHINIST.

# Alphabetical Index to Advertisers


| | PAGE |
|---|---|
| Abrasive Material Co. | 122 |
| Acme Machinery Co. | 105 |
| Adams Co. | 118 |
| Advance Machinery Co. | 98 |
| Albro-Clem Elevator Co. | 118 |
| Almond Mfg. Co., T. R. | 114 |
| American Emery Wheel Wks. | 121 |
| American Gas Furnace Co. | 127 |
| American Pulley Co. | 113 |
| American School of Correspondence | 99 |
| American Swiss File and Tool Co. | 3d cover |
| American Tinol Co. | 102 |
| American Tool Works Co. | 8 |
| American Tube and Stamping Co. | 143 |
| American Wood Working Machinery Co. | 124 |
| Ames & Co., B. C. | 102 |
| Armstrong-Blum Mfg. Co. | 120 |
| Armstrong College | 102 |
| Armstrong Bros. Tool Co. | 119 |
| Automatic Machine Co. | 77 |
| Baker Bros. | 93 |
| Barnes Co., Wallace | 107 |
| Barnes Co., W. F. & John | 14 |
| Barnett Co., G. & H. | 50 |
| Bath Grinder Co. | 85 |
| Baush Machine Tool Co. | 7 |
| Bay State Stamping Co. | 124 |
| Beaman & Smith Co. | 15 and 114 |
| Beaudry & Co., Inc. | 104 |
| Becker Milling Machine Co. | 23 |
| Bemis & Call Hardware and Tool Co. | 105 |
| Besly & Co., Chas. H. | 101 |
| Betts Machine Co. | 6 |
| Bignall & Keeler Mfg. Co. | 110 |
| Bilgram Machine Wks. | 116 |
| Billings & Spencer Co. | 132 |
| Birdsboro Steel Fdry. & Mach. Co. | 113 |
| Blaisdell Machinery Co. | 110 |
| Blanchard Machine Co. | 103 |
| Bliss Co., E. W. | 32 |
| Blount Co., J. G. | 122 |
| Boker & Co., Hermann | 83 |
| Boston Gear Works | 116 |
| Boston Saw and Tool Co. | 120 |
| Bradford Machine Tool Co. | 5 |
| Bradley & Son, C. C. | 104 |
| Bristol Co. | 4th cover |
| Brown & Co., R. H. | 114 |
| Brown & Sharpe Mfg. Co. | 73 and 4th cover |
| Browning & Co., Victor R. | 112 |
| Brubaker & Bros., W. L. | 98 |
| Buffalo Fdry. & Machine Co. | 99 |
| Bullard Machine Tool Co. | 49 |
| Butterfield & Co. | 98 |
| Caldwell & Son Co., H. W. | 131 |
| Carborundum Co. | 26 |
| Card Mfg. Co., S. W. | 31 |
| Carpenter Tap & Die Co., J. M. | 104 |
| Carter & Hakes Machine Co. | 132 |
| Carver File Co. | 124 |
| Chadwick & Trefethen | 102 |
| Chambersburg Engineering Co. | 125 |
| Champion Tool Works Co. | 98 |
| Chicago Flexible Shaft Co. | 129 |
| Chicago House Wrecking Co. | 95 |
| Chicago Machine Tool Co. | 123 |
| Chicago Raw Hide Mfg. Co. | 116 |
| Cincinnati Bickford Tool Co. | 10 |
| Cincinnati Chuck Co. | 114 |
| Cincinnati Electrical Tool Co. | 110 |
| Cincinnati Gear Co. | 116 |
| Cincinnati Gear Cutting Machine Co. | 144 |
| Cincinnati Lathe & Tool Co. | 99 |
| Cincinnati Milling Machine Co. | 24 and 25 |
| Cincinnati Planer Co. | 16 |
| Cincinnati Shaper Co. | 144 |
| Clark Cast Steel Cement Co. | 126 |
| Clayton Air Compressor Wks. | 110 |
| Cleveland Auto. Mach. Co. | 18 |
| Cleveland Crane & Engineering Co. | 112 |
| Cleveland Planer Works | 124 |
| Cleveland Twist Drill Co., | 1 and 4th cover |
| Clough, R. M. | 118 |
| Clum & Atkinson | 125 |
| Contes Clipper Mfg. Co. | 141 |
| Coes Wrench Co. | 34 |
| Colburn Machine Tool Co. | 92 |
| Consolidated Press and Tool Co. | 132 |
| Cook Co., Asa S. | 99 |
| Crocker-Wheeler Co. | 111 |
| Crosby Steam Gage & Valve Co. | 17 |
| Cumberland Steel Co. | 102 |
| Curtis & Curtis Co. | 98 |
| Cushman Chuck Co. | 115 |
| Cushman Electric Co. | 108 |
| Davis-Bournonville Co. | 125 |
| Davis Machine Co., W. P. | 98 |
| Defiance Machine Wks. | 105 |
| Detrick & Harvey Mach. Co. | 99 |
| Diamond Chain & Mfg. Co. | 102 |
| Diamond Machine Co. | 91 |
| Diamond Saw and Stamping Works | 99 |
| Dickinson, Thos. L. | 50 |
| Dill Slotter People | 132 |
| Dixon Crucible Co., Jos. | 103 |
| Dorman, John H. | 100 |
| Dreses Machine Tool Co. | 9 |
| Drucklieb, C. | 125 |
| Earle Gear & Mach. Co. | 118 |
| Eastern Machinery Co. | 112 |
| Electric Welding Products Co. | 125 |
| Electro Dynamic Co. | 110 |
| Elmes Engineering Works, Chas. F. | 98 |
| Emmert Mfg. Co. | 100 |
| Errington, F. A. | 115 |
| Evans Friction Cone Co. | 112 |
| Excelsior Needle Co. | 105 |
| Farrel Fdry. & Mach. Co. | 128 |
| Fawcus Machine Co. | 118 |
| Fay & Scott | 50 |
| Fay Machine Tool Co. | 134 |
| Fellows Gear Shaper Co. | 27 |
| Felton, Sibley & Co. | 130 |
| Ferracute Machine Co. | 99 |
| Firth-Sterling Steel Co. | 129 |
| Fitchburg Machine Works | 96 |
| Flather Mfg. Co., E. J. | 100 |
| Flather Planer Co., Mark | 98 |
| Foote-Burt Co. | 124 |
| Fort Wayne Electric Wks. | 108 |
| Fortuna Machine Co. | 109 |
| Fosdick Machine Tool Co. | 16 |
| Foster Machine Co. | 120 |
| Franklin Mfg. Co. | 127 |
| Gang Co., Wm. E. | 106 |
| Gardner Machine Co. | 120 |
| Garwood Electric Co. | 109 |
| Gem Mfg. Co. | 120 |
| General Electric Co. | 108 |
| General Fire Extinguisher Co. | 140 |

# A Metal Dynamograph and Results

## Adapted to a Planer, It Determines Hardness of Material by Recording Pressures on the Tool When Cutting at Uniform Depth and Feed

BY W. A. KNIGHT

This piece of apparatus was devised for the purpose of furnishing a ready and accurate means of determining the hardness of the different materials used in machine-shop practice. It was developed and built by me at the shops of the Ohio State University in 1898-99. It is based on the principle of measuring the pressure of the chip on the tool, having all conditions constant, except the material operated upon.

It has since been shown by the Taylor experiments that this does not furnish an accurate index to the cutting speed of a metal, but I believe it will be conceded that it is the nearest approach to it of anything available at the present time, outside of an actual test of the cutting speed by finding at what speed a standard tool will be ruined in 20 minutes, as proposed by Mr. Taylor. Evidently this is an impossible test under any but the most favorable conditions. Again, while it is true that other factors, such as tensile strength, elongation, etc., enter the problem, there is no doubt but that the power required to force a tool into a metal and turn the chip is the greatest of these factors. If we confine the tool-pressure tests to a comparison of metals of like character, that is, cast iron with cast iron, steel forging with steel forging, but not steel forging with a steel casting, the results should be a nearer approach to indicating the cutting speed, while if the comparisons are further restricted to the range of hardness ordinarily met with in practice, the results should be still more reliable.

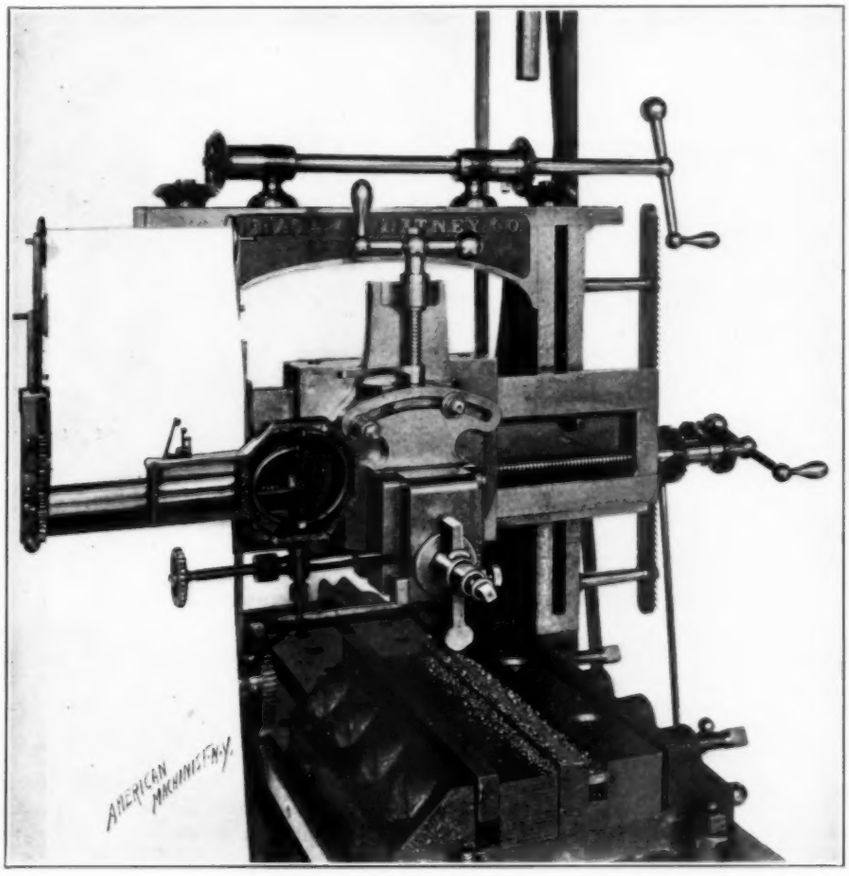


FIG. 1. THE DYNAMOGRAPH IN POSITION ON PLANER

The very great range of hardness of the different metals used in shop practice makes it extremely doubtful if any one single test can be devised to cover this range; the cutting speed of iron and steel alone, according to Taylor, varying from 1 to 100, to say nothing of brass, copper, aluminum, etc. It seems logical, therefore, to divide the materials up into sections, as, for instance, cast iron, low-carbon steel, high-carbon steel, tool steel, steel castings, etc., and make comparisons each with its own kind.

Taking cast iron as an example, the pressure at the point of the tool was found to run from 120 to 232 pounds. The cutting speed, as given by Mr. Taylor, is with a standard 3/4-inch tool, depth of cut 3/16 inch, feed 1/16 inch, for soft cast iron 97, medium 48, and hard cast iron 28 feet per minute. In passing through all grades of cast iron from soft to hard, we pass through all intermediate grades, and in passing through all cutting speeds from 28 to 97, we pass through all intermediate speeds; in other words, both are continuous functions. If we have a casting that is between medium and soft, the cutting speed should be between 48 and 97 feet, while the pressure should be between 120 and 176. A test, then, of a piece of unknown cast iron by the tool-pressure method should place it somewhere within reasonable limits of where it belongs in the scale of cutting speed. Even if it does not, the classification as to soft, medium or hard should be based upon this pressure and not upon the cutting speed. The ill effects of hard castings on such tools, taps and reamers, tool breakages, the strain and wear on machine tools and the power required to drive them are directly dependent upon this pressure. In many cases these considerations outweigh that of cutting speed alone. The same reasoning applies to other metals.

At the time of building the dynamograph there had been some work done along the same line, of which may be mentioned the drill test for cast iron, as originated by Charles Bauer, of Springfield, Ohio (AMERICAN MACHINIST, April 1, 1907), and elaborated by J. W. Keep. Lathe-tool dynamometers had been constructed and experiments on the pressure of the chip on the tool carried out. Most of these were for the purpose of determining the best tool angles and the power required to drive machine tools. The Bauer method was the only one used exclusively for the purpose of determining hardness.

It will be recalled that in this method there is a constant pressure put upon the drill, and the number of revolutions required to penetrate a given depth is taken as a measure of the hardness. It is open to this objection: that if the pressure be fixed so that the drill will penetrate soft iron at about the right rate, that is, so as to get a normal feed for the drill, it will not penetrate hard cast iron at all. The drill will simply glaze the surface, and it would require an infinite number of turns

to drill the given depth. This, according to the standard adopted, would indicate the specimen to be of infinite hardness. Still, it will be possible to drill the hard specimen by sufficiently increasing the pressure. It would seem, therefore, that *the depth of cut should be kept constant,* and the *varying pressures* taken as the measure of hardness.

Of the experiments on pressure of chip, nearly all had been made by measuring the power consumed in driving the tool, with more or less complicated mechanism interposed between the source of power and the tool. This introduced the uncertain element of friction. In the apparatus under consideration, it was sought to eliminate these objectionable features.

The planer was selected in preference to the lathe or drill press because it gave a straight-line cut. There would be no uncertainty about the effect of turning a chip from different diameters. The chip would always be cut from a plane surface. There would be no feeding while the tool was in the metal. It would be possible to maintain cuts of more uniform depth because the spring of the work and wear of centers would be eliminated. On a lathe a slight change in hight of tool with respect to centers would change the angles of rake and clearance. On the planer this would be avoided. Any shaped piece that could be held in a chuck, or clamped to the table, could be tested. A number of different pieces could be held in a chuck and operated upon at the same time.

### Description of Apparatus

A steel block 3x3x1⅛ inch is recessed out to form an oil chamber, this being closed by a thin brass diaphragm upon which rests a plunger. The steel block is placed behind the tool post of a Pratt & Whitney 16x16-inchx3-ft. planer in such a way that the back end of the tool post rests against the plunger. See Fig. 1. Then, pressure applied to the tool is communicated to the oil through the medium of tool post, plunger and diaphragm. A connection is made from the oil chamber to the tubes of a Bourdon pressure gage. To the free ends of the Bourdon tubes is attached a parallel motion carrying a pencil. See Figs. 1 and 2. To the cross-rail of the planer is attached a base plate upon which is mounted two rollers, geared together, and to which motion is communicated from the planer table by means of racks and pinions. During the forward or cutting stroke a strip of paper is drawn through the rolls, while at the same time pressure on the tool causes the pencil to move across the paper, thus registering the pressure at every point of the stroke. The motion of paper relatively to that of planer table is as 1 to 4. The accompanying illustrations, Figs. 1 and 2, show the device in position on the planer, and disassembled.

Referring now to Fig. 3, there is seen a section through the tool post and oil chamber. *A* is the steel block; *b*, the oil chamber; *c*, the diaphragm; *d*, the plunger; *e*, an angular nut, which holds the diaphragm to its seat; *f*, a steel pin with spherical ends, introduced for the purpose of bringing the thrust on the plunger below the center of gravity, so as to eliminate the tendency to bind in the nut. The plunger *d* is made of tool steel, hardened, ground and lapped to as perfect a bearing as possible in the nut *e*.

The apron or clapper *k* carrying the tool post *g* is of special construction, so made as to allow the insertion of the steel block behind it.

The tool post resting against the plunger must of necessity move with it, and although this motion is very small, being but 0.015 inch for the extreme range of pressures, such motion would, if a tool of the ordinary kind were used, cause the tool point to dig into the work and would make the taking of a given depth of cut very uncertain. Hence, a tool holder *h* was made with provision for inserting a tool *i* such that the point is directly under the center of rotation *o* of the clapper *k*. This arrangement also facilitates the maintenance of constant tool conditions.

At *J* is an eccentric tongue which raises the tool clear of the work on the back stroke, thus eliminating the tendency to nick the tool.

### The Cutting Tool

The tool is made of ⅜-inch square steel. It was quenched in water, while at a low red heat and left in that condition, the the temper not being drawn at all. The tool as originally made was of the form shown by Fig. 4. It was found, however, that it was extremely difficult to set the tool so that the flat point was exactly parallel to the planed surface, and that any slight deviation from true parallelism would cause a difference in pressure for the same depth of cut, depending on which direction the tool was fed. Another objectionable feature of this tool was that the leading sharp corner wore away rapidly, thus introducing another element of uncertainty in the results.

For these reasons the tool was discarded and that of Fig. 5 substituted. The point of this tool is ground to a circular form of 7/32-inch radius, while the angle of the cutting edge is 70 degrees. The slot in the tool holder makes an angle of 15 degrees with the vertical and, hence, the tool in cutting position has 15 degrees top rake and 5 degrees clearance. The tool as modified gave excellent satisfaction and is believed to be as good as can be devised for the purpose. It is easy to duplicate and holds a good cutting edge, two of the essential features of a standard tool.

### The Recording Mechanism

Referring now to Fig. 9 there is a connection from the oil chamber to the Bourdon tubes *t t*. It has a valve *n* by means of which the oil can be shut off from the tubes. At *O* is a screw plunger working through a stuffing box and is for the purpose of regulating the quantity of oil in the tubes and chamber. At *P* is a brass frame carrying the tubes and parallel motion, also another arm *q* which carries an inker and draws the zero or base line of the diagram. The rack *x* has motion communicated to it from the planer table by means of rack and pinion (not shown on the drawing, see halftone) and transmits its motion through the gear *y* to the rollers *r r*. In the gear *y* is a pawl and ratchet so that the rollers are driven in one direction only. Paper is drawn from a roll situated above, over the plane surface *z*, thence between the rollers and out below.

Fig. 7 shows the base plate *w* on which are mounted the standards *s s*. The lower standards are hinged about the point *S'* and a projecting arm of the standards is forced outward by the springs *u u*. When

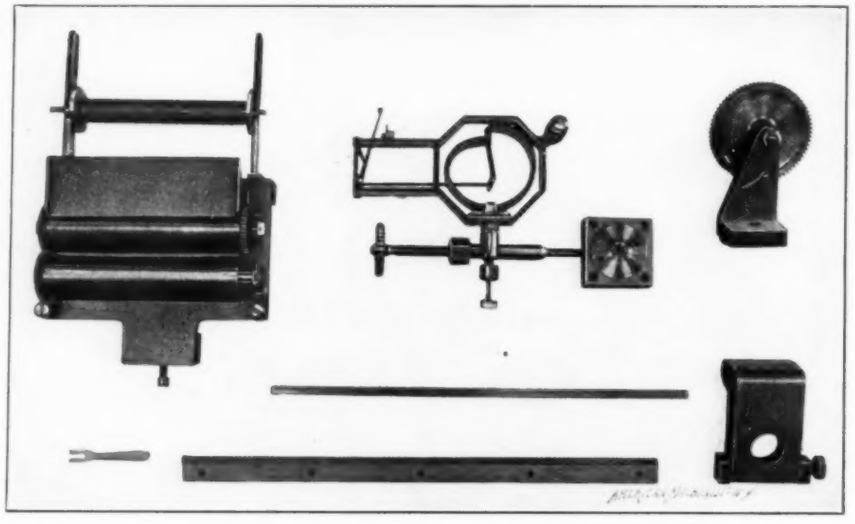


FIG. 2. THE DYNAMOGRAPH DISASSEMBLED

the thumb nuts $v\,v$ are tightened down, the springs are compressed and the rollers separated, thus permitting the insertion of paper between them. When the thumb nuts are unscrewed the springs force the rollers together with a yielding pressure.

The pencil arm $q$ was made to carry a pencil, but it was found that the friction of the pencil on paper was such that it seriously interfered with the accuracy of results. A metallic point was then tried on prepared paper; the results were, however, no better. An inker was then made of the size and shape shown enlarged in Fig. 6. A common fluid ink was used and although it gave some trouble occasionally by clogging up, on the whole it was quite satisfactory.

The bearing which guides the lower end of the rack $x$ is provided with an eccentric lever, by means of which the bearing can be shifted far enough to throw the rack out of mesh with the pinion. This is for the purpose of stopping the motion of the rollers and consequently that of the paper when it was not desired to take a diagram.

I may say here that the instrument as at first made had no recording mechanism, the pressure being read from a gage connected directly to the oil chamber. The variations of pressure from one end to the other of a test bar made the reading of the gage difficult and unsatisfactory, and for that reason the autographic attachment was added.

In a former communication it was stated that the depth of the cut was 0.015 inch. This was a mistake. The down-feed screw was a 6-pitch screw and was provided with a collar graduated into 100 parts. Three divisons on the collar then set the tool down 0.005 inch. This would make 0.025 inch for 15 divisions on the collar. A confusion of these two led to an error of statement. The standard depth of cut for cast iron was 0.025 inch and the feed 0.04 inch.

The settling of the tool after starting a cut was a real difficulty and caused considerable trouble until the cause and remedy were discovered. In planing across a surface ¾ inch wide with a feed of 0.04 inch it was possible to get six to ten diagrams, or one for each stroke. To try out the tool and its setting, the tool was fed first in one direction and then the opposite. Careful measurement of the resulting diagrams (run with a planimeter) showed that they invariably got heavier as the cut proceeded. Tightening of the slide did not remedy the trouble and it was only by putting a lock nut on the down feed screw that the difficulty was overcome.

In taking a fine finishing cut over lathe work the writer had learned to use a diamond-point tool ground up to a sharp

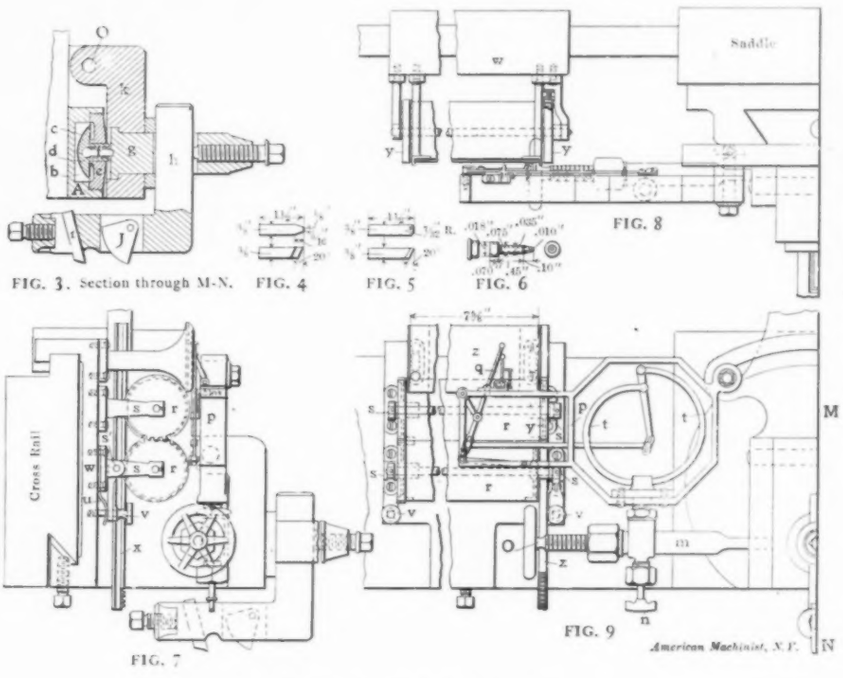



FIG. 3. Section through M-N. FIG. 4 FIG. 5 FIG. 6 FIG. 8 FIG. 7 FIG. 9

DETAILS OF THE DYNAMOGRAPH

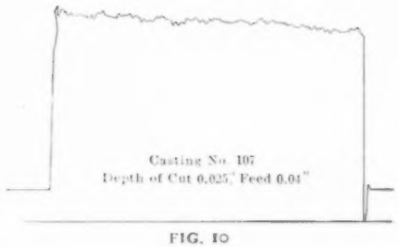



FIG. 10

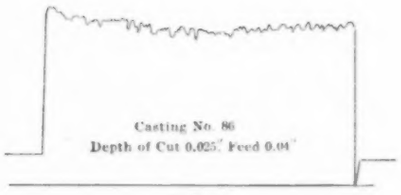



FIG. 11

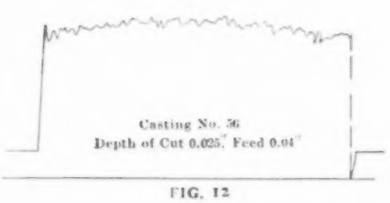



FIG. 12

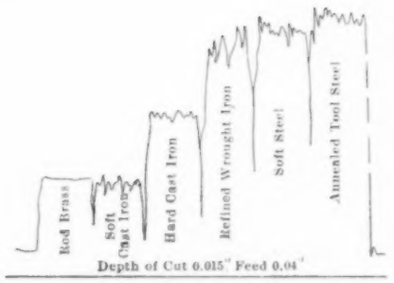



FIG. 13

FIG. 14

TYPICAL DIAGRAMS FROM THE DYNAMOGRAPH

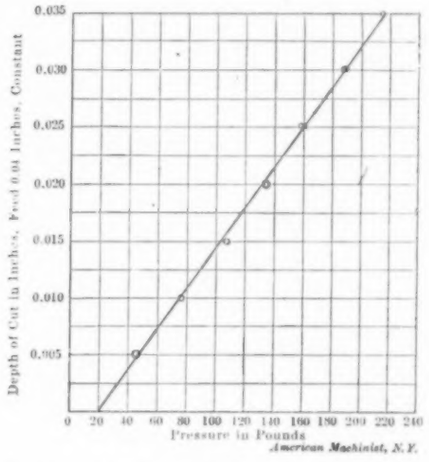



FIG. 15. RELATION BETWEEN PRESSURE AND DEPTH OF CUT ON CAST IRON

point and then flattened off an amount a little greater than the feed. The first tool used with the apparatus was of that form. It was the experience gained during the attempt to use this as a standard tool that led to discarding it for a finishing tool and to the subsequent experiments on lathe tools for finishing cuts, an account of which has already been sent to the AMERICAN MACHINIST.

### TYPICAL DIAGRAMS

Some typical diagrams are shown in Figs. 10, 11 and 12. These were taken from cast-iron specimens, the castings being originally ¾x2x12 inches. They were planed all over to remove the scale before being tested. The diagrams show clearly the variation in hardness along the bar. In some of the pieces the hardest metal was at the center, in others at the end, while in others there was a uniform increase or decrease from one end to the other. In some specimens the variation was 15 per cent. in a length of 12 inches, this, too, in sound castings of uniform cross-section.

Other specimens 2x2x12 inches were cast on end and tested out to see if the top or bottom portion of the casting were the hardest. These pieces were cross-planed so as to leave a projecting spot 2x2 inches at each end and a like spot in the center. Pressure cuts were run across these spots, resulting in separate diagrams for each spot, as shown in Fig. 14. Five pressure cuts were taken for each test, thus giving 15 diagrams for each piece; that is, five from the top, five from the middle and five from the bottom. The five readings were averaged for the final figures. There were 16 of these castings, made from eight different mixtures of pig iron, two being cast at each heat. An average of all the results indicated the bottom of the castings to be harder than the top by 4.7 per cent. The greatest difference in any one casting was 10 per cent. Table 1 gives tabulated value of hardness and also shows the mixture from which the different castings were made. It will be observed that mixture No. 6 gave the softest castings.

The analyses of the various irons, as far as obtainable, are given in Table 2.

| Casting. | Hardness. Bottom. | Middle. | Top. | Mixture. | Weights in Pounds. | |
|---|---|---|---|---|---|---|
| 1, 1 | 225 | 217 | 221 | All machine scrap. | | 500 |
| 1, 2 | 225 | 218 | 217 | | | |
| 2, 1 | 200 | 189 | 190 | Machine scrap. | 425 | |
| 2, 2 | 200 | 180 | 191 | Ashland pig. | 75 | 500 |
| 3, 1 | 191 | 186 | 192 | Machine scrap. | 350 | |
| 3, 2 | 199 | 185 | 186 | Ashland pig. | 75 | |
| | | | | No. 2 foundry. | 75 | 500 |
| 4, 1 | 157 | 148 | 147 | Machine scrap. | 275 | |
| 4, 2 | 164 | 161 | 158 | Ashland pig. | 75 | |
| | | | | No. 2 foundry. | 75 | |
| | | | | Clinton B. | 75 | 500 |
| 5, 1 | 158 | 151 | 147 | Machine scrap. | 200 | |
| 5, 2 | 158 | 155 | 150 | Ashland pig. | 75 | |
| | | | | No. 2 foundry. | 75 | |
| | | | | Clinton B. | 75 | |
| | | | | Soft bessemer. | 75 | 500 |
| 6, 1 | 144 | 138 | 132 | Machine scrap. | 125 | |
| 6, 2 | 140 | 134 | 135 | Ashland pig. | 75 | |
| | | | | Clinton B. | 75 | |
| | | | | No. 2 foundry. | 150 | |
| | | | | Soft bessemer. | 75 | 500 |
| 7, 1 | 169 | 167 | 156 | Machine scrap. | 100 | |
| 7, 2 | 168 | 167 | 160 | Ashland. | 50 | |
| | | | | Clinton B. | 100 | |
| | | | | No. 2 foundry. | 100 | |
| | | | | Soft bessemer. | 75 | |
| | | | | No. 2 cold blast. | 75 | 500 |
| 8, 1 | 217 | 218 | 217 | Machine scrap. | 100 | |
| 8, 2 | 220 | 220 | 217 | No. 2 foundry. | 100 | |
| | | | | Soft bessemer. | 100 | |
| | | | | No. 2 cold blast. | 200 | 500 |

TABLE 1. HARDNESS AND MIXTURE OF VARIOUS CAST IRONS.

Fig. 13 shows a diagram resulting from taking a cut over six different metals at the same time. A noticeable feature of this is the smooth pressure line given by the brass. This is characteristic of rod or sheet brass.

Since the primary object of making the apparatus was to furnish a means of testing for hardness, no experiments were made on tool angles. There was one experiment, however, made to see how the pressure varied with depth of the cut, that is worthy of record. A piece of cast iron originally 1x2x12 inches was planed down to ⅝x1¼x12 inches, this for the purpose of getting uniform material. A first cut of 0.005 inch was taken and the depth of cut increased 0.05 inch each time until a depth of 0.035 inch was reached. Then starting again with 0.005 inch the process was repeated. This gave two cuts of like depth, but from different parts of the bar. The tool was reground and reset after each cut, so that the test served as a check upon the accuracy of the work, as well as to show how the pressure varied with the depth of cut. The readings are given in Table 3 and are plotted in Fig. 15. The resulting pressures lie very nearly on a straight line, which can be represented by the equation $P = 5.6\,d + 20$, in which $P$ = pressure in pounds at tool point, and $d$ = depth of cut in thousandths of inches. This would give a pressure of about 70 tons per square inch of cut.

| | | |
|---|---|---|
| Machine scrap | No analysis... | |
| Ashland pig | Silicon | 8.00 |
| | Sulphur | 0.03 to 0.05 |
| No. 2 foundry | Silicon | 1.35 |
| | Sulphur | 0.045 |
| | Graphite | 3.05 |
| | Com. carbon | 0.35 |
| Soft bessemer | Silicon | 1.50 to 2.25 |
| | Sulphur | 0.015 to 0.030 |
| | Phos. | 0.088 to 0.090 |
| | Mang. | 0.03 |
| Clinton B | Silicon | 1.75 to 2.14 |
| | Sulphur | 0.015 to 0.025 |
| | Phos. | 0.50 to 0.65 |
| | Mang. | 0.50 to 0.65 |
| | Graphite | 3.06 to 3.25 |
| | Com. carbon | 0.20 to 0.40 |
| No. 2 cold blast | No analysis | |

TABLE 2. ANALYSES OF IRONS OF TABLE 1.

| No. of Cut. | Depth of Cut, Inch. | Feed, Inch. | Pressure, Pounds. |
|---|---|---|---|
| 1 | 0.005 | 0.04 | 45 |
| 7 | 0.005 | 0.04 | 46 |
| 2 | 0.010 | 0.04 | 76.5 |
| 8 | 0.010 | 0.04 | 76 |
| 3 | 0.015 | 0.04 | 107 |
| 9 | 0.015 | 0.04 | 106 |
| 4 | 0.020 | 0.04 | 134 |
| 10 | 0.020 | 0.04 | 134 |
| 5 | 0.025 | 0.04 | 160 |
| 11 | 0.025 | 0.04 | 158 |
| 6 | 0.030 | 0.04 | 187 |
| 12 | 0.030 | 0.04 | 189 |
| 17 | 0.035 | 0.04 | 215 |

TABLE 3. RELATIONS BETWEEN PRESSURE AND DEPTH OF CUT ON CAST IRON.

---

It has become an almost weekly occurrence during the last year for the newer large ocean-going steamers to break all previous records in the time consumed to cross the Atlantic. Few people realize the enormous increased engine power required on a ship to clip a comparatively little time from the ocean record. In the "Mauretania," the steamer that now holds sway on the Atlantic, the engine power is 70,000, as against 30,000 on the "Kaiser Wilhelm der Grosse," which was the holder of the record but a few years ago. And while the size of the ship and the increased cost of labor and materials enters into the great increase in the total cost of building the ocean-going steamers in the past ten years the effort to outdistance all others in speed is the main cost increaser. Whereas the "Kaiser Wilhelm der Grosse" cost a little more than $2,500,000 in 1897 the estimated cost of the "Mauretania," completed last year, is given at $6,750,000.

# Some Typewriter Shop Tools

By J. P. Quinn

In the accompanying sketches will be seen the Hammond typewriter shuttle, and some devices used in its manufacture at the Hammond shops in New York City. This shuttle is not a permanent fixture on the machine, but is a light, instantly removable and interchangeable affair, which is made in 35 different languages and 216 styles.

There are on this shuttle ninety characters which are formed in true alinement in three rows upon its face of vulcanite which is in the form of an arc of a circle. To assure accuracy in spacing, the company has built a very accurate master indexing machine which it uses in laying out master type wheels. These wheels themselves, though made of steel, soon wear out and others have to be made; thus it is necessary to have several gaging devices, which are used by the engravers in scribing off the location of the characters on the periphery of the steel master type wheels. The device is shown in Fig. 1. The type wheel is shown at *A* and is made of the finest steel; it is finished to size all over and two holes, one in the center and the other 1 3/16 inches from it are made clear through it. The wheel then goes to the engravers who lay off the location of the letters and it is then sent to the tool room to have the bulk of the material between the rows as well as at each end of them removed to a certain depth; then the engravers work the remainder of the material out which generally takes about three weeks.

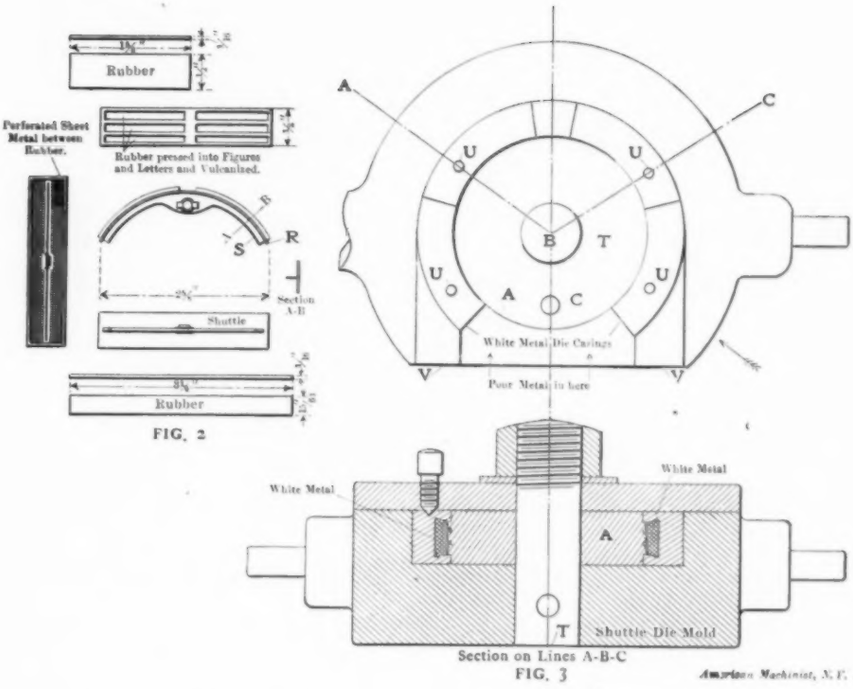



FIG. 2

FIG. 3

TYPEWRITER SHUTTLE AND MOLD FOR SHUTTLE DIE

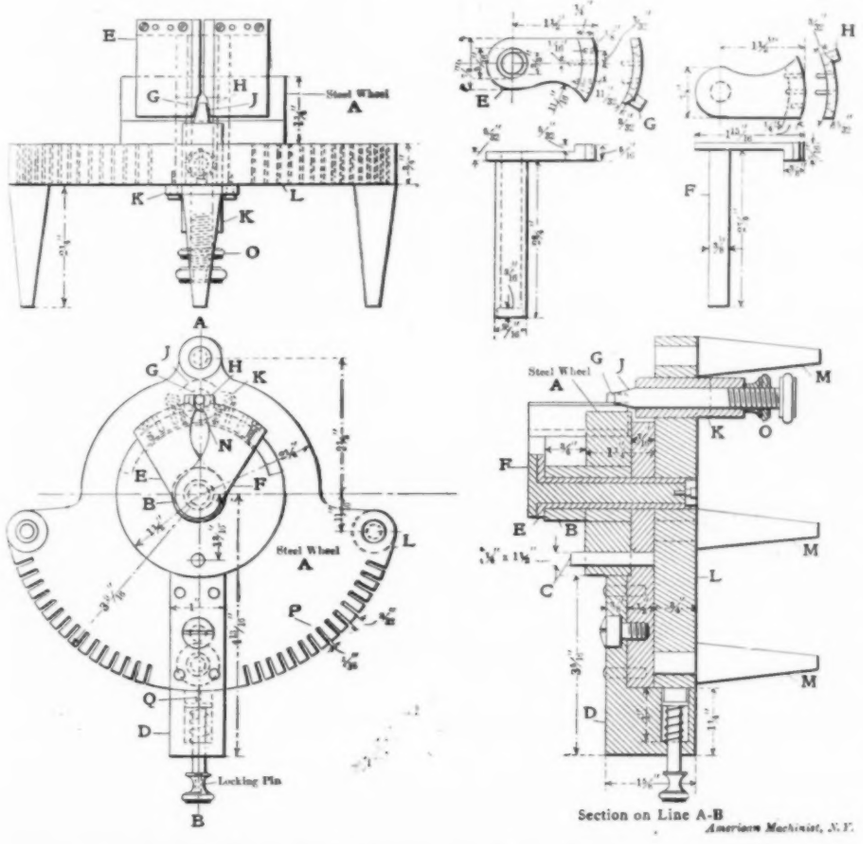



FIG. 1. ENGRAVER'S GAGE FOR LOCATING LETTERS ON STEEL MASTER TYPE WHEELS FOR TYPEWRITERS

The master type wheel is set on the top face of the gaging device and located by a bushing *B* which is the same diameter on the outside as the hole in the wheel and inside as the diameter of the spindle of the swinging arm *E*. The master type wheel is further secured by a pin *C* which locks it to the swinging arm *D*, while passing through the center of arm *D* and the base plate *L* is the hollow spindle of the swinging arm *E* and passing through this hollow spindle is the steel stud of the swinging arm *F*. On the outer faces of swinging arms *E* and *F* are two projections *G* and *H*, which have their inner vertical surfaces tapered to correspond to the taper on the end of the locating pin *J*; this tapered pin is held in a bushing *K* which is secured to the under side of the base plate *L*, while the base plate is supported by four tapered feet *M*.

To accommodate the difference in the widths of the letters the locating pin *J* is screwed through the bushing *K* and by adjusting it up or down the two swinging arms are held an equal distance from the center line *N* and give various widths. A locking nut *O* is provided to secure the locating pin.

The accurate spacing of the letters is obtained by means of the thirty slots *P* on the periphery of the base plate *L*. These slots are 1/16 inch wide by 3/8 inch deep and were laid out by the master indexing machine previously referred to. Riding over these slots is a boss on the end of the swinging plate *D*, and through this boss works a spring locking pin which has on its end a steel blade that just fits the slots in the periphery of the base plate.

The swinging arms which are prevented from coming closer together than for the

desired spacing, are still free to swing away from the center in opposite directions, thus allowing the engraver to remove the arms from the face of the wheels to see the complete surface of the master wheel.

In Fig. 2 is shown a shuttle in detail and also in assembled form. It consists of a thin piece of perforated sheet metal *R* formed in an arc to which is riveted another piece of the same material though not perforated, that stands out from it at right angles as shown in section on line *A B*. On both faces of the perforated section are pressed and vulcanized thin sheets of rubber, part of which material has passed through the perforations in the metal and practically combined and tied the sheets together. On the outer face the type, ninety in number, are formed from a white-metal die. These dies are made from the master steel type wheel *A*, Fig. 1, previously described. The steel type wheel is set over a stud *T* in the center of a chamber in the cast-iron mold as shown in Fig. 3 and the wheel is prevented from turning by the pin going through the hole *C*. Between this steel wheel and the outer lines of the chamber in the mold are placed steel die castings that have their inner faces cut back in dovetail form to receive the white metal as it flows in from the mouth of the mold. The mold and parts may be best seen in the section along lines *A*, *B* and *C*, Fig. 3. The castings are held in position by set screws which protrude through the top plate and enter the spots designated as *U*; the top plate is then clamped on the mold by means of the large nut. The molds are heated to remove the chill and then poured. They are then set in a bath to cool. They last but a short time when they are remelted and formed into new ones. By this process shuttles are made and sold for the small sum of $2.50.

### A Special Indexing and Drilling Jig

Another manufacturing problem that has confronted the company in the construction of its typewriter is that of producing an accurately drilled top index plate.

This plate as shown in Fig. 4 is of cast iron and has drilled through it in the arc of a circle, thirty 0.073 holes in two groups of 15 each. Accuracy in the location of these holes is very important, as through them work the indexing pins which are forced up as the keys of the typewriter are forced down by the operator. These pins regulate the throw or the position of the shuttle by stopping the circular movement of the shuttle arm as the shuttle revolves in the anvil, and any inaccuracy in the location of the holes will throw the pin out and show in the spacing of the writing on the typewriter. Thus it is necessary that the index plate should be perfect. This drilling device is carefully handled and the slightest wear on any of the thirty bushings or drill is detected by the operator when he tests the castings on a multiplying test gage which he is provided with.

The index plate which is shown in Fig. 4, in two positions within the drilling jig, is first ground and all large holes on line *E F* drilled. Two of these holes *A* and *B*, are used as jigging points. The hole *A* is most important of all as it represents the center point of the typewriter and most all of the parts of the typewriter

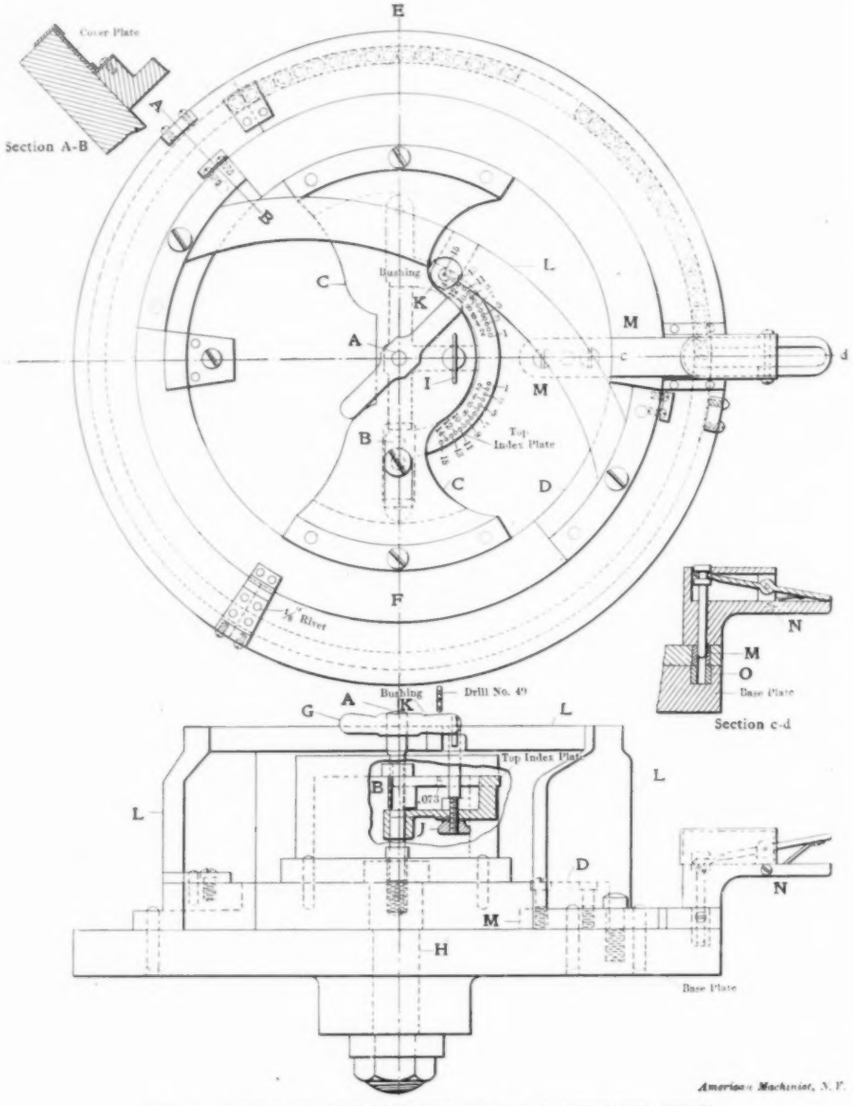



FIG. 4. INDEXING AND DRILLING JIG FOR TYPEWRITER WORK

are machined therefrom. It will be noticed that the drill jig pivots from this point *A* and that *B* is merely the locking point for the casting, bringing it true relatively to the 30 steel bushings on the outer face of the base plate and the steel drill bushing true with the center line of the thirty small holes to be drilled.

The locating and locking points *A* and *B* are in the rotating section of the jig and in placing the casting therein, it is inserted from one side under the bridge section *C*, which spans the turn table *D* and is about 2¾ inches above it. From the under side of this bridge projects the steel pin *B* (see side elevation), which is the same diameter as the hole *B* in the index plate. With this pin in the hole, and the center pin *A* placed through the bridge where it enters the index plate and the end of the stationary stud *H* upon which the table revolves, the third pin *I*, which is the binding pin, is slipped through the bridge and through a hole in the arm of the index plate; the nut *J* is then screwed onto it and binds the casting to the under side of the bridge in correct position relative to the drill bushing *K*. The drill bushing is supported above the casting from a stationary circular-shaped bridge *L* that takes a support from the face of the base plate and spans both turn table and bridge *C* and *D*.

Attached to the turn table *D* from the under side is the extension arm *M*, which reaches out to the periphery of the base plate and carries at the end the turn table locking device *N* through which works a pin operated by a lever which is shown in lower position in the side

elevation and in upper position in the section on line *c-d*. This pin works in the thirty steel bushings in the base plate. These bushings are of steel, hardened and ground to exact size, and set side by side in a circular channel in the base plate till he reaches No. 15, which is the position shown in the sketch; he then starts back at No. 1 on the other side of the center and proceeds in like fashion till the other fifteen holes have been drilled. The casting is then replaced by another

to bring the index plate casting to be drilled in correct position under the drill bushing *K*.

In operation the workman starts at hole No. 1, and works away from the center to be drilled in the same manner. After drilling a few castings the operator tests them in the gage provided. To finish the castings they are counterbored from the under side which removes all burs.

D = diameter of shaft.
D′ = diameter of ball race.
C = diameter of inner ball circle.
C′ = diameter of outer ball circle.
P = chordial pitch of inner row of balls.
P′ = chordial pitch of outer row of balls.
B = diameter of ball.
N = number of balls.

T = thickness of ball race.
t = thickness of brass washer.
g = depth of groove in ball race.
r = radius of groove in ball race.
d = diameter of dowel-pins in brass washers.
n = number of dowel-pins in brass washers.
W = total width of bearing.

All dimensions are in inches.

| D | D′ | C | C′ | P P′ | B | N | T | t | g | r | d | n | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 8 | 5½ | 6½ | 2.1047<br>2.4874 | 1 | 16 | 3/16 | 3/8 | 5/32 | 0.666 | 1/4 | 4 | 2 3/4 |
| 4½ | 8½ | 6 | 7 | 2.2961<br>2.7788 | 1 | 16 | 3/16 | 3/8 | 5/32 | 0.666 | 1/4 | 4 | 2 3/4 |
| 5 | 9 | 6½ | 7½ | 2.2231<br>2.5652 | 1 | 18 | 3/16 | 3/8 | 5/32 | 0.666 | 1/4 | 4 | 3 |
| 6 | 10 | 7½ | 8½ | 2.5652<br>2.9072 | 1 | 18 | 3/16 | 3/8 | 5/32 | 0.666 | 1/4 | 4 | 3 |
| 7 | 11 | 8½ | 9½ | 2.6266<br>2.9357 | 1 | 20 | 3/16 | 3/8 | 5/32 | 0.666 | 1/4 | 4 | 3 |

PROPORTIONS OF BALL THRUST WASHERS WITH DOUBLE ROWS OF BALLS.

D = diameter of shaft.
D′ = diameter of ball race.
C = diameter of ball circle.
P = chordial pitch of balls.
B = diameter of ball.
N = number of balls.
T = thickness of ball race.

t = thickness of brass washer.
g = depth of groove in ball race.
r = radius of groove in ball race.
d = diameter of dowel-pin in brass washers.
n = number of dowel-pins in brass washers.
W = total width of bearing.

All dimensions are in inches.

| D | D′ | C | P | B | N | T | t | g | r | d | n | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ⅝ | 1 7/16 | 1 1/16 | 0.5272 | 1/4 | 8 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 1 |
| 1 | 2 | 1½ | 0.5130 | 1/4 | 9 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 1 |
| 1¼ | 2 1/16 | 1 7/16 | 0.5408 | 1/4 | 10 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 1 1/16 |
| 1½ | 2½ | 2 | 0.5176 | 1/4 | 12 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 1 1/16 |
| 1½ | 3 | 2 1/16 | 0.6953 | 1/4 | 10 | 1/16 | 1/8 | 3/32 | 0.333 | 1/8 | 3 | 1 1/16 |
| 1½ | 3 | 2 1/16 | 0.5284 | 1/4 | 14 | 1/16 | 1/8 | 3/32 | 0.2916 | 1/8 | 3 | 1 1/16 |
| 1½ | 3½ | 2½ | 0.7043 | 1/4 | 11 | 1/16 | 1/8 | 3/32 | 0.333 | 1/8 | 3 | 1 1/16 |
| 1½ | 3 1/16 | 2 7/16 | 0.7919 | 1/4 | 10 | 1/16 | 1/8 | 3/32 | 0.4166 | 1/8 | 3 | 1 1/16 |
| 1½ | 3½ | 2½ | 0.9406 | 1/4 | 9 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 |
| 2 | 3½ | 2½ | 0.5467 | 1/4 | 15 | 1/16 | 1/8 | 3/32 | 0.2916 | 1/8 | 3 | 1 1/16 |
| 2 | 3½ | 2½ | 0.7117 | 1/4 | 12 | 1/16 | 1/8 | 3/32 | 0.333 | 1/8 | 3 | 1 1/16 |
| 2 | 3 1/16 | 2 7/16 | 0.7279 | 1/4 | 12 | 1/16 | 1/8 | 3/32 | 0.4166 | 1/8 | 3 | 1 1/16 |
| 2 | 4 | 3 | 0.9271 | 1/4 | 10 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 |
| 2¼ | 3 1/16 | 2 7/16 | 0.7603 | 1/4 | 12 | 1/16 | 1/8 | 3/32 | 0.4166 | 1/8 | 3 | 1 1/16 |
| 2¼ | 3¼ | 2½ | 0.5610 | 1/4 | 16 | 1/16 | 1/8 | 3/32 | 0.2916 | 1/8 | 3 | 1 1/16 |
| 2¼ | 4 | 3¼ | 0.8088 | 1/4 | 12 | 1/16 | 1/8 | 3/32 | 0.4166 | 1/8 | 3 | 1 1/16 |
| 2¼ | 4¼ | 3½ | 0.9156 | 1/4 | 11 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 |
| 2¼ | 4½ | 3½ | 1.0429 | 1/4 | 10 | 1/16 | 1/8 | 3/32 | 0.5833 | 1/8 | 3 | 2 1/16 |
| 2¼ | 4½ | 3½ | 0.8376 | 1/4 | 13 | 1/16 | 1/8 | 3/32 | 0.4166 | 1/8 | 3 | 1 1/16 |
| 2¼ | 4½ | 3½ | 0.9059 | 1/4 | 12 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 |
| 2¼ | 4½ | 3½ | 1.1202 | 1/4 | 10 | 1/16 | 1/8 | 3/32 | 0.5833 | 1/8 | 3 | 2 1/16 |
| 2¼ | 4½ | 3½ | 0.8345 | 1/4 | 14 | 1/16 | 1/8 | 3/32 | 0.4166 | 1/8 | 3 | 1 1/16 |
| 2¼ | 4½ | 3½ | 0.8984 | 1/4 | 13 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 |
| 2¼ | 5 | 3¾ | 1.0917 | 1/4 | 11 | 1/16 | 1/8 | 3/32 | 0.5833 | 1/8 | 3 | 2 1/16 |
| 3 | 4½ | 3½ | 0.7316 | 1/4 | 16 | 1/16 | 1/8 | 3/32 | 0.333 | 1/8 | 3 | 1 1/16 |
| 3 | 5 | 4 | 0.7804 | 1/4 | 16 | 1/16 | 1/8 | 3/32 | 0.4166 | 1/8 | 3 | 1 1/16 |
| 3 | 5 | 4 | 0.8901 | 1/4 | 14 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 |
| 3 | 5½ | 4½ | 1.0676 | 1/4 | 12 | 1/16 | 1/8 | 3/32 | 0.5833 | 1/8 | 3 | 2 1/16 |
| 3¼ | 5½ | 4½ | 1.047 | 1/4 | 13 | 1/16 | 1/8 | 3/32 | 0.5833 | 1/8 | 3 | 2 1/16 |
| 3¼ | 5½ | 4½ | 0.9023 | 1/4 | 16 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 1/16 |
| 3¼ | 5½ | 4½ | 1.0292 | 1/4 | 14 | 1/16 | 1/8 | 3/32 | 0.5833 | 1/8 | 3 | 2 1/16 |
| 3¼ | 5½ | 4½ | 0.8248 | 1/4 | 18 | 1/16 | 1/8 | 3/32 | 0.4166 | 1/8 | 3 | 1 1/16 |
| 3¼ | 6 | 4¾ | 1.0136 | 1/4 | 15 | 1/16 | 1/8 | 3/32 | 0.5833 | 1/8 | 3 | 2 1/16 |
| 4 | 5½ | 4½ | 0.7429 | 1/4 | 20 | 1/16 | 1/8 | 3/32 | 0.333 | 1/8 | 3 | 1 1/16 |
| 4 | 6½ | 5½ | 0.9998 | 1/4 | 16 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 1/16 |
| 4 | 6½ | 5½ | 0.9998 | 1/4 | 16 | 1/16 | 1/8 | 3/32 | 0.5833 | 1/8 | 3 | 2 1/16 |
| 5 | 6½ | 5½ | 0.7668 | 1/4 | 24 | 1/16 | 1/8 | 3/32 | 0.333 | 1/8 | 3 | 1 1/16 |
| 5 | 7½ | 6½ | 1.0616 | 1/4 | 18 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 1/16 |
| 5½ | 7½ | 6½ | 0.7682 | 1/4 | 26 | 1/16 | 1/8 | 3/32 | 0.333 | 1/8 | 3 | 1 1/16 |
| 5½ | 7½ | 6½ | 1.0364 | 1/4 | 20 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 1/16 |
| 6 | 8½ | 7½ | 1.1341 | 1/4 | 20 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 1/16 |
| 7 | 9½ | 8½ | 1.2906 | 1/4 | 20 | 1/16 | 1/8 | 3/32 | 1/8 | 1/8 | 3 | 2 1/16 |

PROPORTIONS OF BALL THRUST WASHERS WITH A SINGLE ROW OF BALLS.

# Proportions of Ball Thrust Washers

By O. Savillion

The accompanying tables, compiled from actual practice, give the dimensions of a type of ball-thrust washers shown in Figs. 1 and 2, and will be of assistance to those engaged in designing machine tools, power transmission appliances and engineering work in general.

In construction, the brass washers, which form the split-ball cage for retaining the balls, are bored an easy fit to suit the shaft, and are doweled together with steel dowel pins. The hardened steel washers or ball races should be ground

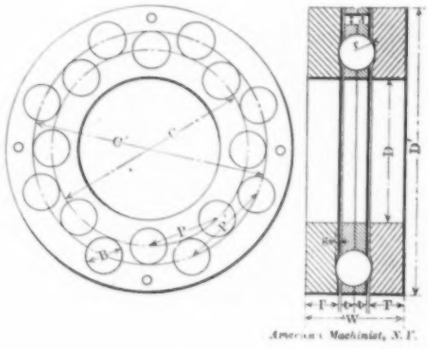



FIG. 1. DIAGRAM OF SINGLE ROW BALL THRUST BEARING

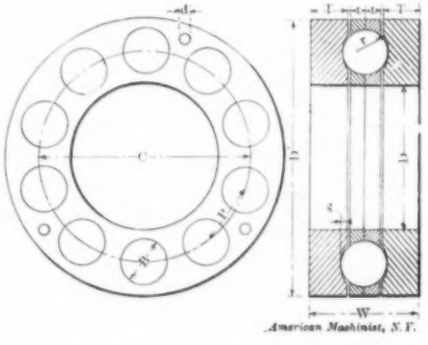



FIG. 2. DIAGRAM OF DOUBLE ROW BALL THRUST BEARING

5/1000 inch larger than the sizes given in column D (i.e., the diameter of shaft), in order that the shaft may revolve freely inside the stationary ball race. It is not necessary to provide keys for these ball races, one washer will rotate with the shaft while the other remains stationary, the friction of the balls on the race being so slight that the friction on the plain surface is sufficient to prevent rotation.

The proportion taken for the radius of groove in the ball races equals 2/3 diameter of ball.

# The Nonmagnetic Ship "Carnegie"

## The Metal Fittings for the "Carnegie" from the Cook Stove in the Galley to the Knives in the Sailors' Pockets are of Nonmagnetic Metal

BY E. A. DIXIE

Never since the Bronze Age (and probably not even then) until the building of the "Carnegie" has a vessel of this size been made without wrought iron or mild steel in her construction and equipment.

Her displacement is about 600 tons and there is no wrought iron or mild steel, and less than one pound of cast iron, in her construction for each ton displacement.

### Object of the Institution

The object of the institution is the promotion of investigation "in the broadest and most liberal manner." Many projects in widely different fields of inquiry have been considered or are under consideration. Among these is the department of terrestrial magnetism, founded April 1, 1904, of which Dr. L. A. Bauer, The Ontario, Washington, D. C., is in charge.

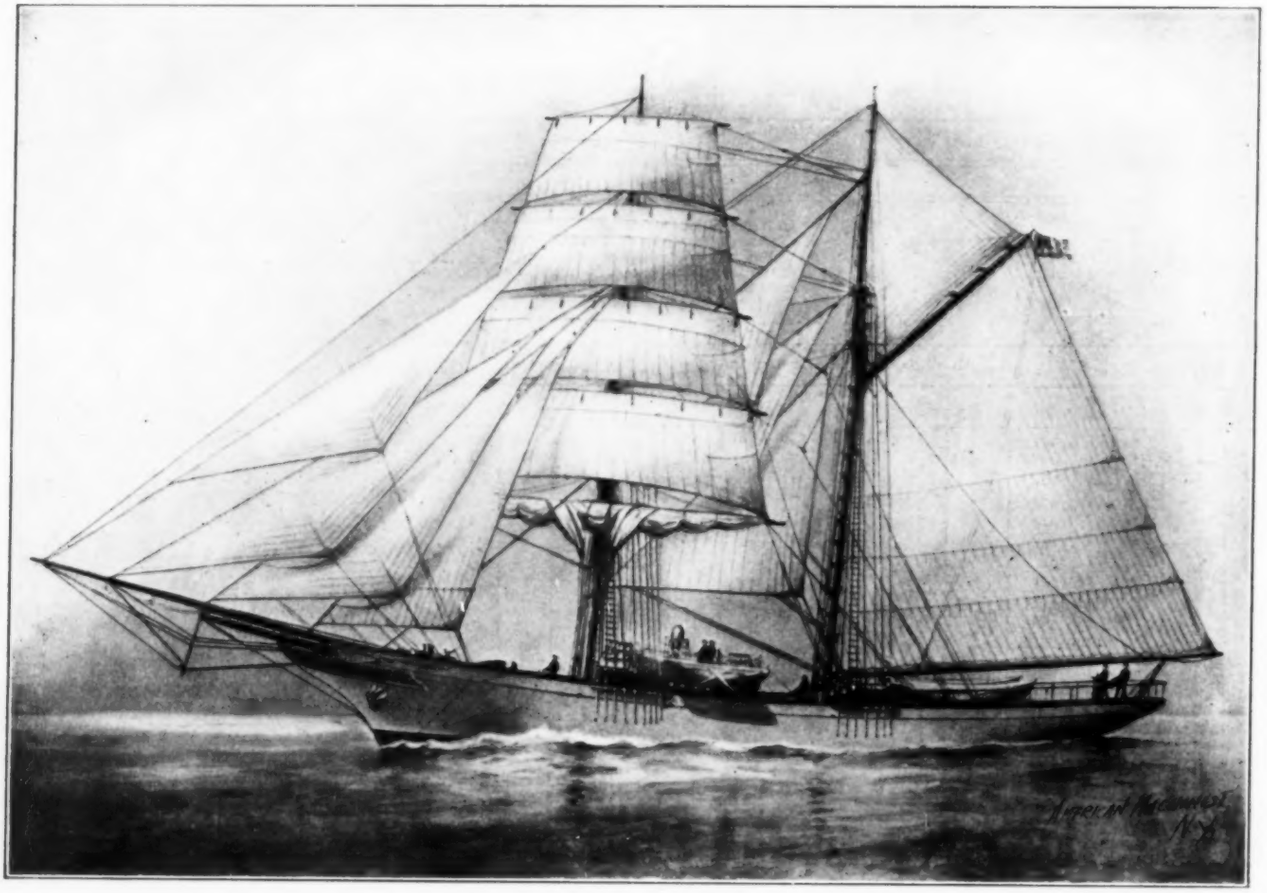


FIG. 1. THE NONMAGNETIC SURVEY YACHT "CARNEGIE"

### The Endowment of the Carnegie Institution

January 28, 1902, Andrew Carnegie gave to a board of trustees $10,000,000 in registered bonds, yielding 5 per cent. annual interest. On December 10, 1907, he added $2,000,000 to this. With this endowment the institution was originally organized as the Carnegie Institution. Later it was incorporated by an act of Congress, approved April 28, 1904, under the title Carnegie Institution of Washington.

For the pursuit of the investigation of terrestrial magnetism the "Carnegie" has been built.

### A Trial Made with a Partially Nonmagnetic Ship

The first vessel used for survey purposes was the "Galilee," a vessel which was chartered and adapted as well as conditions would permit.

She made a general magnetic survey of the Pacific extending from the Aleutian islands on the north to New Zealand on the south, Asia on the west and the Americas on the east. Her cruises aggregated 60,000 miles and extended from August 1, 1905, to June 1, 1908.

Owing to the fact that iron and steel, both magnetic metals, enter largely into the construction of ships, sensitive magnetic instruments are liable to the influences of such iron and steel parts and accurate readings of such instruments are not possible where such local attraction exists. The "Galilee" was stripped of magnetic fittings wherever possible, but it was obviously impossible to remove all iron and steel from a vessel already built and built without the knowledge that she would some day be devoted to this magnetic research work. The results obtained with her were, however, so satisfactory (errors of 4 to 5 degrees being found in charts) that it was decided to build a vessel as nearly not magnetic as possible and this decision resulted in the launching of the "Carnegie" on the 12th of June,

1909, her keel having been laid in the middle of February, 1909.

### Why the Compass Does Not Always Point North

It is now well known that the compass or magnetic needle points true north and south at but few places on the earth. In all other places it points either east or west of true north.

In the United States there is a long narrow belt, running approximately through Columbus, Ohio, and Columbia, South Carolina, where the north end of the compass *at present* points either exactly or nearly true north. I use the term "at present" because the magnetic pole is not fixed in position but is at present apparently moving westward. This change is called "secular variation" and amounts to as much as ten degrees or more in a century.

To give an idea of the variation of the compass in the United States from Maine on the east to Washington on the west, it would be found that north as indicated by the compass would vary from 20 degrees west of north to 24 degrees east of north in these two States respectively.

### Those Directly Interested and Why

The mariner, the surveyor and the explorer rely upon the compass or magnetic needle to guide and serve them for their purposes. They must hence have charts showing how the compass points at all parts of the globe and by what amount it changes from year to year. In the existing charts of the oceans the latitudes and longitudes, the depths, the directions and speeds of currents and variations of the compass, etc., are put down for the mariners' guidance. The variations as set down in these charts are known to be incorrect and the supplying of true magnetic charts and compass data is one of the chief objects of the magnetic survey and incidentally of the "Carnegie."

If one were to start from New York City with a compass in hand and follow the direction pointed by the north end of the needle he would be led across Lake Ontario into Canada, along the east side of James bay across Hudson bay in the direction of Boothia Felix in Arctic North America where the north magnetic pole seems at present to be situated. As he approaches this point the needle would become more and more fickle and less and less inclined to point in a definite direction. Right at, or above, the magnetic pole it would point in any direction and would be no more use for telling direction than a ham sandwich.

### Another Instrument used by Magneticians

Thus we see, the force exerted by the earth as a magnet upon the compass becomes less and less as the magnetic pole is approached and at this point its influence while still extant is, because of apparent lack of direction, of no value to the observer. However, the magnetician is fortunately not dependent upon the compass alone, he has another instrument, the dip circle or dip needle as it is commonly called. This is practically a compass needle hung on a horizontal instead of a vertical axis; the needle is thus capable of swinging freely in a vertical plane. The needle of the dip circle would at the magnetic poles stand exactly vertical.

Thus we see why the compass needle becomes so erratic at the magnetic poles, because the magnetic force or pull is at this point in a vertical direction.

### The Magnetic Equator

Half way between the magnetic poles there is a line similar to the geographic equator but not coincident with it called the magnetic equator. The magnetic equator intersects the geographic equator at various points and here the dip needle would lie precisely horizontal.

### Offsetting the Influence of "Dip"

As the compass approaches the magnetic poles the vertical "pull" referred to has the tendency to pull or dip the *compass needle* the same as it does the *dip needle*. This force acting on the compass needle is overcome by a small adjustable weight attached to the opposite arm of the needle. Thus, in the north magnetic hemisphere the weight would be on the south pole of the compass needle. How much the needle dips at various parts of the earth and the amount of dip and the change in dip from time to time will be another task for the magnetic survey to determine.

I might fill this issue of the American Machinist from cover to cover telling the various known problems which it is intended that the magnetic survey shall solve and then the story would be but partly told for in all research work discovery leads on in an endless chain to other discoveries. One peculiar fact is known about the magnetic poles, they are not antipodal to each other and a straight line connecting them would miss the center of the earth by about 750 miles or about 1/5 of the earth's radius. This gives a reason for the very irregular distribution of magnetism throughout the earth.

### The Earth A Gigantic Magnet

The earth is thus shown to be a gigantic magnet and is capable the same as other magnets of communicating magnetism to other magnetizable bodies on its surface. Previous to the advent of iron and steel in ships this phenomenon did not make itself particularly obnoxious, but since these metals have become the principal ones used in naval construction it has been found that if an iron ship is built on stocks running north and south, it becomes a permanent magnet and its influence on the compasses used by its navigators render them if not useless at

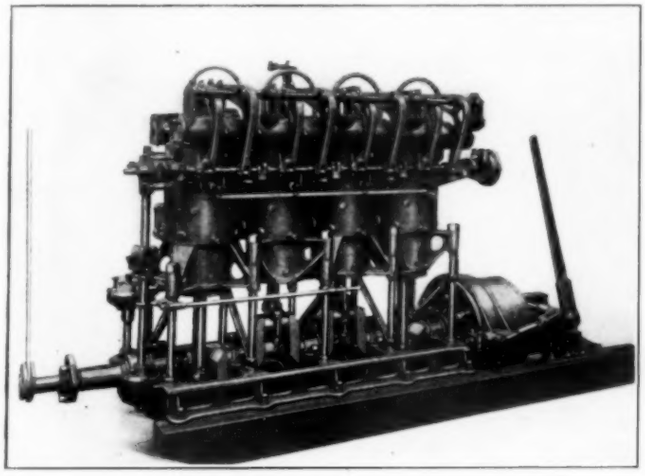


FIG. 2. FRONT VIEW OF THE ENGINE

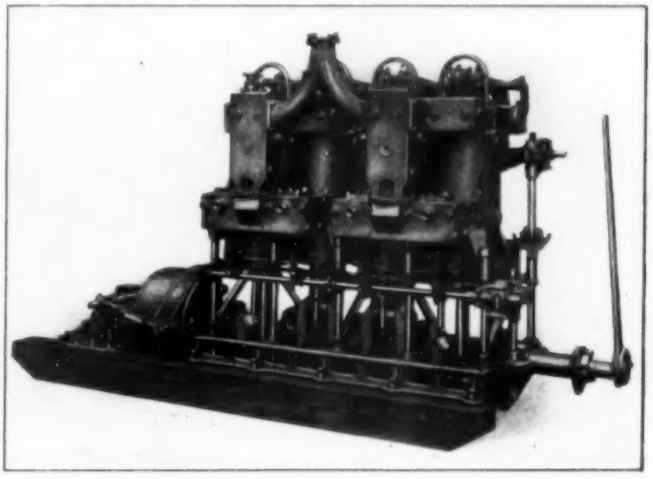


FIG. 3. REAR VIEW OF THE ENGINE

least unreliable. The "setting" of the magnetism in the ship is also aided by the vibration due to the setting up of the rivets with hand and pneumatic hammers. For this reason, all ship yards or at least all stocks for metal ships are built approximately east and west. This same peculiar tendency to become permanent magnets is noticeable to a marked degree in steel and iron ships taking long voyages in a generally northerly or southerly direction. In any case, no matter what direction an iron vessel sails the magnetism of the ship is forever changing.

### The Nonmagnetic Vessel

The "Carnegie" combines the seaworthy qualities of an ocean-going vessel with the neat trim appearance and comforts of a private yacht.

Her hull was designed by Henry J. Gielow, engineer and naval architect, 52 Broadway, New York, who is himself an amateur scientist of no mean ability. Thus the designing of her called from him not only his best effort as a designer of ships but the interest and enthusiasm of the scientific devotee.

### The Builder of the "Carnegie's" Engine

The engine was designed and is being built by James Craig, Jr., 556 West Thirty-fourth street, New York, who designed and built the internal combustion engines for the submarine boats "Octopus," "Cuttlefish," etc., and except for necessary variations caused by the use of producer gas instead of gasolene and the use of nonmagnetic metal, is the same as the engines installed in the submarines.

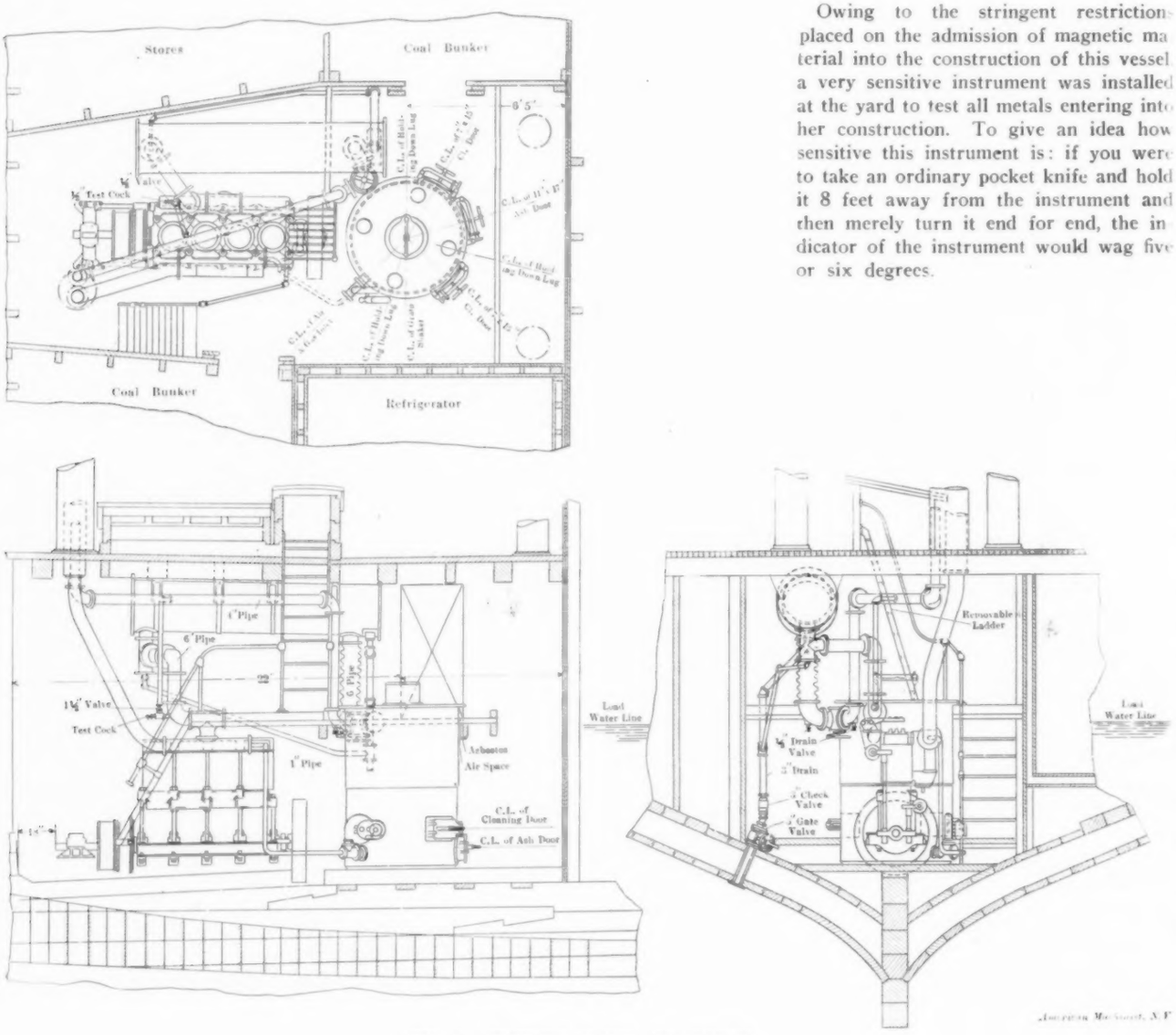



FIG. 4. PRODUCER PLANT AND ENGINE

### The Builder of the "Carnegie"

The "Carnegie" was built at the foot of Twenty-third street, Brooklyn, under the supervision of Wallace Downey, vice-president and manager of the Tebo Yacht Basin Company, by William H. Payne constructor. In passing I may mention that the famous yacht "Meteor" built for the Emperor of Germany and the three masted schooner yacht "Atlantic" built for Wilson Marshall, of Bridgeport, Conn. and which won the Emperor of Germany's gold medal in the international transatlantic race in 1905, were both built by these two men.

### Restrictions Placed on the Materials

Owing to the stringent restrictions placed on the admission of magnetic material into the construction of this vessel a very sensitive instrument was installed at the yard to test all metals entering into her construction. To give an idea how sensitive this instrument is: if you were to take an ordinary pocket knife and hold it 8 feet away from the instrument and then merely turn it end for end, the indicator of the instrument would wag five or six degrees.

The hull of the "Carnegie" is of wood which is fastened together with "treenails" (which are wooden spikes driven into bored holes; these treenails are usually made of locust wood) and bolts and spikes of nonmagnetic bronze. Where thin wood and canvas are to be fastened, copper and bronze nails and tacks are used. Every bolt, spike and nail has been tested for magnetism and it is a noteworthy fact that out of the many thousands of metal fastenings used, but *seven* spikes have failed to pass inspection.

### Her Dimensions

The "Carnegie" is 155 feet 6 inches over all, 33 feet beam, has a depth of hold 12 feet 9 inches and a mean draft of 12 feet 7 inches. With all stores and equipment on board her displacement is 568 tons.

The keel, stem, stern post, frames and deadwood are of white oak grown, cut and sawed at Jamaica Plains, Greater New York, within twelve miles of the ship yard where she was built.

The deck beams, planking and ceiling are of yellow pine, and the deck is of Oregon pine in long lengths. The keel is 12x18 inches and to this is fitted a false keel 12x4 inches.

### Her Rig

She is brigantine rig; what this means can be seen by referring to Fig. 1, and spreads 12,900 square feet of plain sail. From the foremast truck (the top of the front mast) to the water surface is 122 feet and from the forward end of the bowsprit to the after end of the main boom is 201 feet.

The rigging is of Russian hemp, of special make.

It was decided to install auxiliary propulsion in the "Carnegie" so as to provide headway when taking off-shore observations, where the vessel could be with difficulty handled by the sails and to prevent interruptions in the observations by maintaining headway during calms.

### Why a Producer Gas Engine was Chosen

The necessity of providing means of propulsion which would be nearly nonmagnetic in character, made the type of plant somewhat difficult of selection.

The only type of prime mover which could be built at a reasonable price and maintained in reliable operation with a minimum amount of nonmagnetic metal in its construction, appeared to be an internal-combustion engine.

Consideration of the available fuel for such a motor resulted in the elimination of gasolene or oil, not only on account of cost, but also because it would be impossible to procure them in the zone to be covered by the "Carnegie" as well as being dangerous in the quantities which would have to be stored for the lengthy voyages which are contemplated. It is well known that many thousands of horsepower are being developed with internal-combustion engines on land using gas generated from solid fuel. A careful investigation showed that a gas producer for marine purposes could be built which would generate producer gas for use in internal-combustion engines from bituminous or anthracite coal, coke, wood, or charcoal, and that such a plant could be constructed almost entirely of nonmagnetic materials. The suction type of gas producer was adopted principally for the reason of its simplicity in construction and operation, and the elimination to a minimum degree of other auxiliary apparatus.

### Power Plant and Cruising Radius

The "Carnegie" is equipped with a four-cylinder Craig internal-combustion engine of 150 horsepower, shown in Figs. 2 and 3. The gas producer, shown in Fig. 4, is furnished by the Marine Producer Gas Power Company, of New York, and consists of a cylinder 6 feet high with a diameter of 5 feet 6 inches built of copper with asbestos and firebrick lining and manganese-steel grates. Anthracite coal will be used as fuel, the gas to be generated in the producer and taken to a special scrubber of copper from which it passes to the internal-combustion engine. The vessel will carry 25 tons of coal in her bunkers which will give her a cruising radius of 2000 nautical miles at a speed of six knots.

### Equipment

The ground tackle comprises four bronze anchors of special design. Two anchors of 1900 pounds each, one of 1335 and a kedge anchor of 340 pounds; three 11-inch hemp cables, each 127 fathoms in length are required for these anchors, as no satisfactory nonmagnetic chain was obtainable. The hawser pipes are of bronze of special design and the boat davits and all metal deck fittings and chain plates are of special bronze. The boat equipment consists of two nonmagnetic gigs. A refrigerating plant constructed of bronze and copper operated by a six-horse-power special engine forms a necessary part of the equipment for a vessel which at times will be a month or more continuously at sea. All living quarters are below, the sailing officers' and crew's quarters being forward, after which are the quarters for the scientific staff mentioned in the machinery space. The living quarters are especially planned with a view to giving good accommodations for all. There will be two galleys, one for the scientific party and the other forward for the crew. Specially designed cooking ranges of bronze and copper have been provided.

### Where the Observations Will Be Taken

Of special interest is the observation room located on the main deck amidship, forward and aft of which are circular observatories with revolving domes, not unlike those of astronomical observatories. It will thus be possible to take magnetic observations both in the open and under shelter inside these observatories. The positions of the stands for the various instruments have been so chosen that any effect resulting from the amount of iron in the machinery (about 500 pounds 30 feet from the instruments), which could not be replaced by nonmagnetic material, would be so small as to be negligible. With regard to the engine itself, the cylinder castings which are usually made of cast iron have been made of special bell metal composed of 80 per cent. copper and 20 per cent. tin. This metal is so hard that it took seven cuts to finish a cylinder. It has been found that the gas carried over from the producer plant sometimes contains sulphuric acid, but this metal will resist its action. The balance of the engine is of special bronze. Owing to the weakness of producer gas the compression space in the engine has been altered. With the ordinary run of gasolene engines the compression is about 75 pounds per square inch; with the producer gas it is necessary to almost double this. For the same reason given above, the valves and induction pipes have been increased to twice the area of valves and induction pipes used in gasolene engines. A special sparking device must also be used as the ignition for producer gas must be most pronounced.

### Magnetic Metal Used

The only parts of magnetic metal used in the engine are the pistons and piston rings which are made of cast iron. Nickel steel is used for the cams and valves. When the question of making the pistons first came up bronze was suggested, but as this is so brittle at high temperatures it was not considered available. The next metal suggested was manganese steel, but this is very difficult to cast and the makers said that they might cast as many as 12 pistons without getting a good one. Another great difficulty with manganese steel is machining it. It cannot be finished with anything but an abrasive wheel.

### Peculiar Facts about Nickel Steel

Mr. Craig then suggested nickel steel and wrote to the Bethlehem Steel Company, one of the makers of this metal. They told him that a 25 per cent. nickel steel would be practically nonmagnetic, and he submitted this information to the Carnegie Institute at Washington. They informed Mr. Craig that while it was true that 25 per cent. nickel steel was not magnetic, if it were allowed to reach as low a temperature as 30 degrees Fahrenheit it would become magnetic and retain it until it was heated to a temperature of about 1100 degrees Fahrenheit.

Sheath knives of sailors are, as a rule, made of carbon steel, but for the sailors of the "Carnegie," special knives of manganese steel have been made which are practically nonmagnetic. If a piece of soft iron is rated as 100, a piece of manganese steel would show only about 1 per cent. of magnetic attraction. What will be done regarding the material for the carpenter's tools has not yet been settled.

# Volumes, Pressures and Temperatures in the Adiabatic Compression of Air

By Frank Richards

The table and chart herewith should be of service to the large and constantly increasing number of workers and investigators in mechanical lines who have to do with compressed air. The actual compression of air in the usual way, in cylinders having reciprocating pistons, is practically adiabatic in each specific case, and in investigating the power requirements, the actual power consumption and other conditions of such compression, it is necessary always to know and consider the pressures, volumes and temperatures involved, and for this work the table and chart here presented should prove a substantial aid.

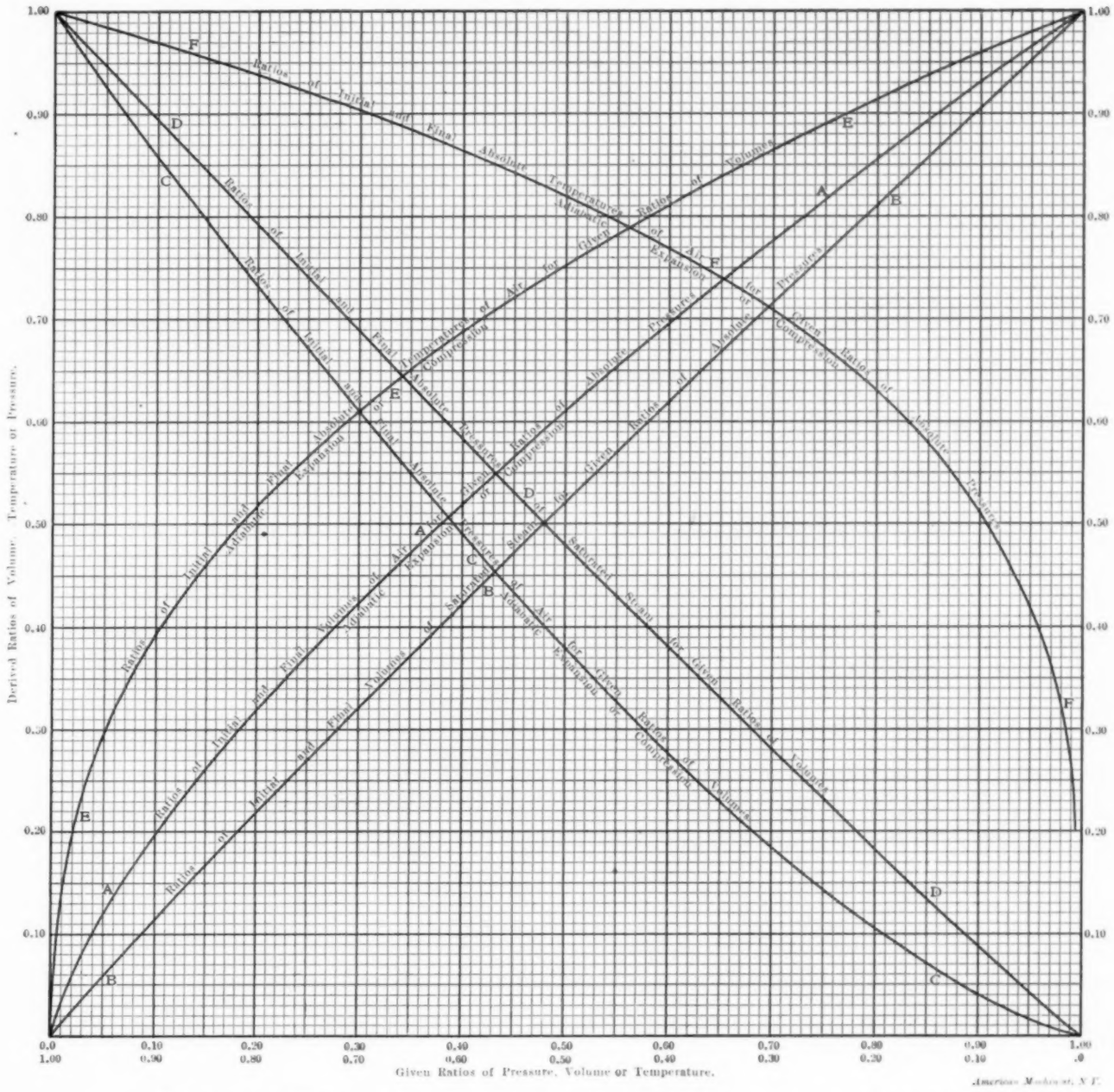
On a little inspection of the table and diagram it will be seen that if we trace the ratio of the initial to the terminal (or *vice versa*) of either the pressures, the volumes or the temperatures of air, compressed and delivered without loss or gain of heat (adiabatic compression), the ratios of the other two particulars are easily determined, and then having the ratio in either case, with the pressure, volume, or temperature at either the beginning or the termination of the act of compression (or expansion), the corresponding pressure, volume or temperature for the other end of the operation also will be known.

Our first and most easily accessible knowledge of any specific operation of compression is as to the pressures at the beginning and at the end of the compression. Thus, say that we are working at or near sea level, or taking in the air at an absolute pressure of 14.7 pounds and delivering the air at 80 pounds gage, the absolute pressure then, of course, being $80 + 14.7 = 94.7$ pounds, the ratio of initial to terminal pressure will be $14.7 \div 94.7 = 0.1552$. With these pressures at the opposite ends of the stroke the ratio will, of course, be the same whether compressing the air in the ordinary reciprocating compressor or expanding the air in doing work in an air engine or motor, only in one case the ratio as given would be the convenient multiplier in our computations and in the other case the reciprocal would apply, so that the reciprocal for every ratio is provided in the table as here given, for practical working purposes.

The table is not entirely new, the principal elements of it having been computed more than 30 years ago by Richard H. Buel and published with other valuable matter, in Appleton's "Cyclopedia of Applied Mechanics." The reciprocals of all the ratios have been added and the chart has been entirely plotted from the

| Ratio. | Reciprocal. | A | Reciprocal. | B | Reciprocal. | C | Reciprocal. | D | Reciprocal. | E | Reciprocal. | F | Reciprocal. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.01 | 100 | 0.0380 | 26.315 | 0.0131 | 76.259 | 0.0015 | 666.66 | 0.0075 | 133.33 | 0.1528 | 6.544 | 0.2633 | 3.799 |
| 0.02 | 50 | 0.0621 | 16.103 | 0.0252 | 39.682 | 0.0041 | 243.90 | 0.0157 | 63.69 | 0.2027 | 4.933 | 0.3219 | 3.106 |
| 0.03 | 33.33 | 0.0829 | 12.062 | 0.0369 | 27.102 | 0.0072 | 138.88 | 0.0241 | 41.49 | 0.2392 | 4.180 | 0.3620 | 2.762 |
| 0.04 | 25 | 0.1017 | 9.832 | 0.0483 | 20.704 | 0.0108 | 92.592 | 0.0327 | 30.58 | 0.2689 | 3.718 | 0.3935 | 2.541 |
| 0.05 | 20 | 0.1191 | 8.396 | 0.0596 | 16.778 | 0.0147 | 68.027 | 0.0414 | 24.15 | 0.2946 | 3.394 | 0.4198 | 2.382 |
| 0.06 | 16.66 | 0.1356 | 7.374 | 0.0708 | 14.039 | 0.0190 | 52.631 | 0.0503 | 19.88 | 0.3173 | 3.151 | 0.4425 | 2.259 |
| 0.07 | 14.28 | 0.1513 | 6.609 | 0.0819 | 12.210 | 0.0237 | 42.194 | 0.0593 | 16.86 | 0.3379 | 2.959 | 0.4627 | 2.161 |
| 0.08 | 12.5 | 0.1663 | 6.013 | 0.0928 | 10.775 | 0.0286 | 34.964 | 0.0683 | 14.64 | 0.3568 | 2.803 | 0.4810 | 2.079 |
| 0.09 | 11.11 | 0.1808 | 5.531 | 0.1037 | 9.643 | 0.0337 | 29.675 | 0.0774 | 12.92 | 0.3744 | 2.671 | 0.4977 | 2.009 |
| 0.10 | 10 | 0.1949 | 5.131 | 0.1145 | 8.733 | 0.0391 | 25.575 | 0.0866 | 11.54 | 0.3908 | 2.558 | 0.5131 | 1.948 |
| 0.11 | 9.091 | 0.2085 | 4.796 | 0.1253 | 7.981 | 0.0447 | 22.371 | 0.0958 | 10.43 | 0.4063 | 2.461 | 0.5275 | 1.895 |
| 0.12 | 8.333 | 0.2218 | 4.508 | 0.1359 | 7.358 | 0.0505 | 19.802 | 0.1051 | 9.522 | 0.4210 | 2.375 | 0.5410 | 1.848 |
| 0.13 | 7.692 | 0.2348 | 4.259 | 0.1466 | 6.821 | 0.0566 | 17.668 | 0.1144 | 8.741 | 0.4350 | 2.298 | 0.5537 | 1.806 |
| 0.14 | 7.143 | 0.2475 | 4.040 | 0.1572 | 6.361 | 0.0628 | 15.923 | 0.1238 | 8.077 | 0.4484 | 2.230 | 0.5657 | 1.767 |
| 0.15 | 6.667 | 0.2599 | 3.847 | 0.1677 | 5.963 | 0.0692 | 14.451 | 0.1332 | 7.507 | 0.4612 | 2.168 | 0.5771 | 1.732 |
| 0.16 | 6.25 | 0.2721 | 3.675 | 0.1782 | 5.611 | 0.0758 | 13.192 | 0.1427 | 7.007 | 0.4735 | 2.112 | 0.5880 | 1.700 |
| 0.17 | 5.882 | 0.2841 | 3.519 | 0.1887 | 5.299 | 0.0825 | 12.121 | 0.1522 | 6.570 | 0.4853 | 2.066 | 0.5984 | 1.671 |
| 0.18 | 5.556 | 0.2959 | 3.380 | 0.1991 | 5.022 | 0.0894 | 11.185 | 0.1617 | 6.188 | 0.4968 | 2.012 | 0.6084 | 1.643 |
| 0.19 | 5.263 | 0.3074 | 3.253 | 0.2095 | 4.773 | 0.0965 | 10.362 | 0.1713 | 5.837 | 0.5079 | 1.968 | 0.6180 | 1.618 |
| 0.20 | 5 | 0.3188 | 3.136 | 0.2199 | 4.547 | 0.1037 | 9.643 | 0.1809 | 5.527 | 0.5186 | 1.930 | 0.6273 | 1.594 |
| 0.21 | 4.762 | 0.3301 | 3.029 | 0.2302 | 4.344 | 0.1111 | 9.001 | 0.1905 | 5.249 | 0.5290 | 1.890 | 0.6362 | 1.571 |
| 0.22 | 4.545 | 0.3412 | 2.930 | 0.2405 | 4.157 | 0.1186 | 8.431 | 0.2001 | 4.997 | 0.5392 | 1.854 | 0.6448 | 1.551 |
| 0.23 | 4.348 | 0.3521 | 2.840 | 0.2508 | 3.987 | 0.1263 | 7.917 | 0.2098 | 4.766 | 0.5490 | 1.821 | 0.6532 | 1.530 |
| 0.24 | 4.167 | 0.3629 | 2.755 | 0.2610 | 3.831 | 0.1341 | 7.457 | 0.2195 | 4.555 | 0.5586 | 1.792 | 0.6613 | 1.512 |
| 0.25 | 4 | 0.3736 | 2.676 | 0.2712 | 3.687 | 0.1420 | 7.042 | 0.2293 | 4.361 | 0.5680 | 1.760 | 0.6692 | 1.494 |
| 0.26 | 3.846 | 0.3841 | 2.603 | 0.2814 | 3.553 | 0.1501 | 6.662 | 0.2390 | 4.182 | 0.5772 | 1.732 | 0.6768 | 1.477 |
| 0.27 | 3.704 | 0.3946 | 2.534 | 0.2916 | 3.429 | 0.1583 | 6.317 | 0.2488 | 4.019 | 0.5861 | 1.706 | 0.6843 | 1.461 |
| 0.28 | 3.571 | 0.4049 | 2.469 | 0.3018 | 3.313 | 0.1666 | 6.000 | 0.2586 | 3.867 | 0.5949 | 1.681 | 0.6915 | 1.446 |
| 0.29 | 3.448 | 0.4151 | 2.409 | 0.3119 | 3.206 | 0.1750 | 5.701 | 0.2684 | 3.725 | 0.6035 | 1.657 | 0.6986 | 1.431 |
| 0.30 | 3.333 | 0.4252 | 2.351 | 0.3220 | 3.105 | 0.1836 | 5.446 | 0.2783 | 3.593 | 0.6119 | 1.634 | 0.7055 | 1.417 |
| 0.31 | 3.226 | 0.4353 | 2.297 | 0.3321 | 3.011 | 0.1922 | 5.203 | 0.2881 | 3.471 | 0.6201 | 1.611 | 0.7122 | 1.404 |
| 0.32 | 3.125 | 0.4452 | 2.246 | 0.3422 | 2.922 | 0.2010 | 4.975 | 0.2980 | 3.355 | 0.6282 | 1.591 | 0.7188 | 1.391 |
| 0.33 | 3.03 | 0.4550 | 2.197 | 0.3522 | 2.839 | 0.2099 | 4.764 | 0.3079 | 3.247 | 0.6361 | 1.572 | 0.7252 | 1.378 |
| 0.34 | 2.941 | 0.4648 | 2.151 | 0.3623 | 2.760 | 0.2189 | 4.568 | 0.3178 | 3.146 | 0.6439 | 1.553 | 0.7315 | 1.365 |
| 0.35 | 2.857 | 0.4744 | 2.108 | 0.3723 | 2.686 | 0.2281 | 4.384 | 0.3278 | 3.050 | 0.6516 | 1.534 | 0.7377 | 1.355 |
| 0.36 | 2.778 | 0.4840 | 2.066 | 0.3823 | 2.615 | 0.2373 | 4.214 | 0.3377 | 2.961 | 0.6591 | 1.517 | 0.7438 | 1.344 |
| 0.37 | 2.703 | 0.4935 | 2.026 | 0.3923 | 2.549 | 0.2466 | 4.055 | 0.3477 | 2.876 | 0.6665 | 1.500 | 0.7497 | 1.333 |
| 0.38 | 2.632 | 0.5030 | 1.988 | 0.4023 | 2.485 | 0.2561 | 3.904 | 0.3577 | 2.795 | 0.6738 | 1.484 | 0.7555 | 1.323 |
| 0.39 | 2.564 | 0.5124 | 1.949 | 0.4122 | 2.426 | 0.2656 | 3.765 | 0.3677 | 2.719 | 0.6810 | 1.468 | 0.7612 | 1.313 |
| 0.40 | 2.5 | 0.5216 | 1.917 | 0.4222 | 2.368 | 0.2752 | 3.633 | 0.3777 | 2.647 | 0.6881 | 1.453 | 0.7668 | 1.304 |
| 0.41 | 2.439 | 0.5309 | 1.883 | 0.4321 | 2.314 | 0.2850 | 3.509 | 0.3878 | 2.578 | 0.6951 | 1.438 | 0.7723 | 1.294 |
| 0.42 | 2.381 | 0.5400 | 1.851 | 0.4420 | 2.262 | 0.2948 | 3.392 | 0.3978 | 2.513 | 0.7019 | 1.424 | 0.7777 | 1.285 |
| 0.43 | 2.326 | 0.5491 | 1.819 | 0.4519 | 2.212 | 0.3047 | 3.281 | 0.4079 | 2.451 | 0.7087 | 1.411 | 0.7831 | 1.276 |
| 0.44 | 2.273 | 0.5582 | 1.791 | 0.4618 | 2.165 | 0.3148 | 3.176 | 0.4180 | 2.392 | 0.7154 | 1.397 | 0.7883 | 1.268 |
| 0.45 | 2.222 | 0.5672 | 1.763 | 0.4716 | 2.122 | 0.3249 | 3.084 | 0.4281 | 2.336 | 0.7220 | 1.385 | 0.7934 | 1.260 |
| 0.46 | 2.174 | 0.5761 | 1.735 | 0.4815 | 2.076 | 0.3351 | 2.984 | 0.4382 | 2.282 | 0.7285 | 1.372 | 0.7985 | 1.252 |
| 0.47 | 2.128 | 0.5850 | 1.709 | 0.4913 | 2.035 | 0.3454 | 2.895 | 0.4483 | 2.230 | 0.7349 | 1.360 | 0.8035 | 1.244 |
| 0.48 | 2.083 | 0.5938 | 1.684 | 0.5012 | 1.979 | 0.3558 | 2.810 | 0.4585 | 2.181 | 0.7412 | 1.349 | 0.8084 | 1.237 |
| 0.49 | 2.041 | 0.6025 | 1.659 | 0.5110 | 1.957 | 0.3663 | 2.730 | 0.4686 | 2.134 | 0.7475 | 1.337 | 0.8133 | 1.229 |
| 0.50 | 2 | 0.6112 | 1.636 | 0.5208 | 1.920 | 0.3768 | 2.654 | 0.4788 | 2.091 | 0.7537 | 1.326 | 0.8180 | 1.222 |
| 0.51 | 1.961 | 0.6199 | 1.613 | 0.5306 | 1.884 | 0.3875 | 2.581 | 0.4890 | 2.045 | 0.7598 | 1.316 | 0.8227 | 1.215 |
| 0.52 | 1.923 | 0.6285 | 1.591 | 0.5404 | 1.850 | 0.3982 | 2.511 | 0.4992 | 2.003 | 0.7658 | 1.305 | 0.8274 | 1.208 |
| 0.53 | 1.887 | 0.6371 | 1.568 | 0.5502 | 1.817 | 0.4091 | 2.443 | 0.5094 | 1.963 | 0.7718 | 1.295 | 0.8320 | 1.201 |
| 0.54 | 1.852 | 0.6456 | 1.549 | 0.5599 | 1.786 | 0.4200 | 2.381 | 0.5196 | 1.924 | 0.7777 | 1.285 | 0.8365 | 1.195 |
| 0.55 | 1.818 | 0.6540 | 1.529 | 0.5697 | 1.755 | 0.4310 | 2.320 | 0.5298 | 1.887 | 0.7836 | 1.276 | 0.8409 | 1.189 |
| 0.56 | 1.786 | 0.6625 | 1.509 | 0.5794 | 1.725 | 0.4420 | 2.262 | 0.5401 | 1.851 | 0.7893 | 1.266 | 0.8453 | 1.183 |
| 0.57 | 1.754 | 0.6708 | 1.491 | 0.5892 | 1.697 | 0.4532 | 2.206 | 0.5503 | 1.817 | 0.7951 | 1.257 | 0.8497 | 1.177 |
| 0.58 | 1.724 | 0.6792 | 1.472 | 0.5989 | 1.669 | 0.4644 | 2.153 | 0.5606 | 1.783 | 0.8007 | 1.248 | 0.8540 | 1.171 |
| 0.59 | 1.695 | 0.6875 | 1.454 | 0.6086 | 1.643 | 0.4757 | 2.102 | 0.5709 | 1.751 | 0.8063 | 1.240 | 0.8582 | 1.165 |
| 0.60 | 1.667 | 0.6957 | 1.437 | 0.6183 | 1.613 | 0.4871 | 2.051 | 0.5812 | 1.720 | 0.8119 | 1.231 | 0.8624 | 1.159 |
| 0.61 | 1.639 | 0.7039 | 1.420 | 0.6280 | 1.592 | 0.4986 | 2.005 | 0.5914 | 1.691 | 0.8174 | 1.223 | 0.8666 | 1.153 |
| 0.62 | 1.613 | 0.7121 | 1.404 | 0.6377 | 1.568 | 0.5101 | 1.960 | 0.6018 | 1.661 | 0.8228 | 1.215 | 0.8706 | 1.148 |
| 0.63 | 1.587 | 0.7203 | 1.388 | 0.6474 | 1.544 | 0.5218 | 1.910 | 0.6121 | 1.633 | 0.8282 | 1.207 | 0.8747 | 1.143 |
| 0.64 | 1.563 | 0.7284 | 1.372 | 0.6570 | 1.522 | 0.5335 | 1.874 | 0.6224 | 1.606 | 0.8335 | 1.199 | 0.8787 | 1.138 |
| 0.65 | 1.538 | 0.7364 | 1.358 | 0.6667 | 1.500 | 0.5452 | 1.835 | 0.6327 | 1.580 | 0.8388 | 1.192 | 0.8827 | 1.132 |
| 0.66 | 1.515 | 0.7445 | 1.343 | 0.6763 | 1.478 | 0.5571 | 1.795 | 0.6431 | 1.554 | 0.8441 | 1.184 | 0.8866 | 1.128 |
| 0.67 | 1.493 | 0.7524 | 1.328 | 0.6860 | 1.457 | 0.5690 | 1.757 | 0.6534 | 1.530 | 0.8493 | 1.177 | 0.8904 | 1.123 |
| 0.68 | 1.471 | 0.7604 | 1.315 | 0.6956 | 1.437 | 0.5810 | 1.721 | 0.6638 | 1.506 | 0.8544 | 1.170 | 0.8943 | 1.118 |
| 0.69 | 1.449 | 0.7683 | 1.301 | 0.7052 | 1.418 | 0.5931 | 1.686 | 0.6742 | 1.483 | 0.8595 | 1.163 | 0.8981 | 1.113 |
| 0.70 | 1.429 | 0.7762 | 1.288 | 0.7148 | 1.399 | 0.6052 | 1.652 | 0.6846 | 1.461 | 0.8646 | 1.156 | 0.9018 | 1.108 |
| 0.71 | 1.408 | 0.7841 | 1.275 | 0.7245 | 1.380 | 0.6174 | 1.619 | 0.6950 | 1.438 | 0.8696 | 1.149 | 0.9055 | 1.104 |
| 0.72 | 1.389 | 0.7919 | 1.263 | 0.7341 | 1.359 | 0.6297 | 1.588 | 0.7054 | 1.417 | 0.8746 | 1.143 | 0.9092 | 1.099 |
| 0.73 | 1.370 | 0.7997 | 1.250 | 0.7436 | 1.344 | 0.6420 | 1.557 | 0.7158 | 1.397 | 0.8795 | 1.137 | 0.9128 | 1.095 |
| 0.74 | 1.351 | 0.8075 | 1.238 | 0.7532 | 1.327 | 0.6545 | 1.527 | 0.7262 | 1.375 | 0.8844 | 1.130 | 0.9165 | 1.091 |
| 0.75 | 1.333 | 0.8152 | 1.227 | 0.7628 | 1.311 | 0.6669 | 1.499 | 0.7366 | 1.357 | 0.8893 | 1.124 | 0.9200 | 1.087 |
| 0.76 | 1.316 | 0.8229 | 1.215 | 0.7724 | 1.294 | 0.6795 | 1.471 | 0.7471 | 1.338 | 0.8941 | 1.118 | 0.9236 | 1.082 |
| 0.77 | 1.299 | 0.8306 | 1.204 | 0.7819 | 1.278 | 0.6921 | 1.444 | 0.7575 | 1.321 | 0.8989 | 1.112 | 0.9271 | 1.078 |
| 0.78 | 1.282 | 0.8382 | 1.193 | 0.7915 | 1.263 | 0.7048 | 1.418 | 0.7680 | 1.302 | 0.9036 | 1.106 | 0.9305 | 1.074 |
| 0.79 | 1.266 | 0.8459 | 1.182 | 0.8010 | 1.248 | 0.7176 | 1.393 | 0.7785 | 1.284 | 0.9083 | 1.100 | 0.9340 | 1.070 |
| 0.80 | 1.25 | 0.8534 | 1.171 | 0.8106 | 1.233 | 0.7304 | 1.369 | 0.7889 | 1.267 | 0.9130 | 1.095 | 0.9374 | 1.066 |
| 0.81 | 1.235 | 0.8610 | 1.161 | 0.8201 | 1.219 | 0.7433 | 1.345 | 0.7994 | 1.251 | 0.9176 | 1.089 | 0.9408 | 1.062 |
| 0.82 | 1.22 | 0.8685 | 1.151 | 0.8296 | 1.205 | 0.7562 | 1.322 | 0.8099 | 1.234 | 0.9222 | 1.084 | 0.9441 | 1.059 |
| 0.83 | 1.205 | 0.8761 | 1.140 | 0.8392 | 1.191 | 0.7692 | 1.300 | 0.8204 | 1.219 | 0.9268 | 1.079 | 0.9474 | 1.055 |
| 0.84 | 1.19 | 0.8835 | 1.131 | 0.8487 | 1.178 | 0.7823 | 1.278 | 0.8309 | 1.203 | 0.9313 | 1.073 | 0.9507 | 1.051 |
| 0.85 | 1.176 | 0.8910 | 1.122 | 0.8582 | 1.165 | 0.7955 | 1.257 | 0.8414 | 1.188 | 0.9358 | 1.068 | 0.9540 | 1.048 |
| 0.86 | 1.163 | 0.8984 | 1.113 | 0.8678 | 1.152 | 0.8087 | 1.236 | 0.8519 | 1.173 | 0.9403 | 1.063 | 0.9572 | 1.044 |
| 0.87 | 1.149 | 0.9058 | 1.104 | 0.8772 | 1.139 | 0.8220 | 1.216 | 0.8625 | 1.159 | 0.9448 | 1.058 | 0.9605 | 1.041 |
| 0.88 | 1.136 | 0.9132 | 1.095 | 0.8866 | 1.127 | 0.8353 | 1.197 | 0.8730 | 1.145 | 0.9492 | 1.053 | 0.9636 | 1.037 |
| 0.89 | 1.124 | 0.9206 | 1.086 | 0.8961 | 1.115 | 0.8487 | 1.178 | 0.8835 | 1.131 | 0.9536 | 1.048 | 0.9668 | 1.034 |
| 0.90 | 1.111 | 0.9279 | 1.077 | 0.9056 | 1.104 | 0.8621 | 1.159 | 0.8941 | 1.118 | 0.9579 | 1.043 | 0.9699 | 1.031 |
| 0.91 | 1.099 | 0.9352 | 1.069 | 0.9151 | 1.093 | 0.8757 | 1.142 | 0.9047 | 1.105 | 0.9623 | 1.039 | 0.9730 | 1.027 |
| 0.92 | 1.087 | 0.9425 | 1.061 | 0.9245 | 1.081 | 0.8892 | 1.124 | 0.9152 | 1.092 | 0.9666 | 1.034 | 0.9761 | 1.024 |
| 0.93 | 1.075 | 0.9498 | 1.052 | 0.9340 | 1.070 | 0.9029 | 1.107 | 0.9258 | 1.080 | 0.9708 | 1.030 | 0.9792 | 1.021 |
| 0.94 | 1.064 | 0.9570 | 1.045 | 0.9434 | 1.059 | 0.9166 | 1.091 | 0.9364 | 1.068 | 0.9751 | 1.025 | 0.9822 | 1.019 |
| 0.95 | 1.053 | 0.9642 | 1.037 | 0.9529 | 1.049 | 0.9303 | 1.074 | 0.9470 | 1.056 | 0.9793 | 1.021 | 0.9853 | 1.014 |
| 0.96 | 1.042 | 0.9714 | 1.029 | 0.9623 | 1.039 | 0.9441 | 1.059 | 0.9576 | 1.044 | 0.9835 | 1.016 | 0.9882 | 1.012 |
| 0.97 | 1.031 | 0.9786 | 1.021 | 0.9717 | 1.029 | 0.9580 | 1.043 | 0.9682 | 1.032 | 0.9877 | 1.012 | 0.9912 | 1.009 |
| 0.98 | 1.020 | 0.9858 | 1.014 | 0.9812 | 1.019 | 0.9720 | 1.029 | 0.9788 | 1.021 | 0.9918 | 1.008 | 0.9942 | 1.006 |
| 0.99 | 1.01 | 0.9929 | 1.007 | 0.9906 | 1.009 | 0.9860 | 1.014 | 0.9894 | 1.011 | 0.9959 | 1.004 | 0.9971 | 1.003 |
| 1.00 | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. |

TABLE OF RATIOS AND RECIPROCALS OF PRESSURE TEMPERATURE AND VOLUME IN THE ADIABATIC COMPRESSION OF AIR


Derived Ratios of Volume, Temperature or Pressure.
Given Ratios of Pressure, Volume or Temperature.
American Machinist, N.Y.

## Relations of Ratios of Pressure, Temperature and Volume in the Adiabatic Compression of Air

### Use of Chart

In the chart the given or known ratios, from which the desired results are to be obtained, are noted horizontally on the base line and the ratio desired is then indicated by the vertical distance from the base line at the point noted to the curve of ratios required in the particular case. The curves *A*, *B* and *E* start from the left-hand corner, and the curves *C*, *D* and *F* from the right-hand corner, the base line being figured for facility of reading in either direction.

Say that we have an air compressor working at an altitude of 2000 feet above sea level compressing 900 cubic feet of free air per minute and delivering it into the receiver at 75 pounds gage pressure. The normal atmospheric pressure at 2000 feet being, say, 1.37 pounds, and the absolute delivery pressure then being 75 + 13.7 = 88.7 pounds, the pressure ratio will be 13.7 ÷ 88.7 = 0.1544. To ascertain now the delivery volume of the air compressor, we take this rating, the first two figures of it as they stand and the other two figures by approximating, and locate it on the base line reading from the left-hand corner. Taking 15 spaces and a little less than a half of the next space we note the vertical distance from this point up to curve *A*, and this we find to be 26, and a little more than half of the next space, say, 26½, or, decimally, 0.2662, and this being the ratio of the terminal to the initial volume, the actual terminal volume per minute will be 900 × 0.2662 = 239.58 cubic feet.

The volume thus ascertained is, of course, the volume actually delivered and at the moment of delivery, assuming that the compression was perfectly adiabatic throughout, or that the body of air, while being compressed, neither lost nor gained any heat by conduction, radiation or otherwise, and as a matter of fact this is nearly the actual state of affairs in ordinary dry compression. If, during compression, the air could be maintained at constant temperature the ratios of volumes would then be practically the same as the ratios of pressures, and the "curve" for this would be a straight diagonal from the lower left-hand to the upper right-hand corner.

To ascertain now the ratio of temperatures as the result of our compression the operation is similar, except that in this case we use curve *F* instead of curve *A*. Taking our ratio of pressures 0.1544, with which we started, but this time reading from the right-hand corner, we find the vertical reading to curve *F* to be 0.58, or so little above this that the excess is negligible. We note in the table that the reciprocal of 0.58 is 1.724, and this it will be convenient to use here. If the initial temperature of the air was 60 degrees Fahrenheit, then the absolute initial temperature would be 60 + 461 = 521, and the terminal temperature would be 521 × 1.724 = 898 absolute, or 898 — 461 = 437 degrees Fahrenheit.

If we take our ratio of volumes 0.2662, as previously ascertained and reading from the left-hand corner note the vertical reading to curve *E*, the ratio of temperatures will be found to be the same as that obtained from curve *F*.

If we take any horizontal line of the chart, or any horizontal line arbitrarily placed upon the chart and note the points where curves *E* and *F* cross it, then the distance from curve *E* to the left-hand vertical boundary will be the ratio of volumes for that temperature ratio and the distance from curve *F* to the right-hand will be the ratio of pressures, so that all particulars embodied in curves *A* and *C* are really obtainable from curves *E* and *F*.

table, the smoothness of the curves in the plotting attesting the accuracy, or at least the consistency, of the figures.

The several curves of the chart are designated by the same letters as the columns of the table to which they correspond, adiabatic compression, or expansion, being assumed throughout. The several series of ratios, whether in the curves of the chart, or in the columns of the table are as follows:

$A$ = Ratios of initial and terminal volumes of air for given ratios of absolute pressures.

$B$ = Ratios of initial and terminal volumes of saturated steam for given ratios of absolute pressures.

$C$ = Ratios of initial and terminal absolute pressures of air for given ratios of volumes.

$D$ = Ratios of initial and terminal absolute pressures of saturated steam for given ratios of volumes.

$E$ = Ratios of initial and terminal absolute temperatures of air for given ratios of volumes.

$F$ = Ratios of initial and terminal absolute temperatures of air for given ratios of absolute pressures.

The formulas (from Rankine) by which the ratios in the several columns were computed are as follows, $\frac{1}{R}$ being the ratio in the first column:

$$A \ldots \left(\frac{1}{R}\right)^{0.71}$$

$$B \ldots \left(\frac{1}{R}\right)^{\frac{10}{17}}$$

$$C \ldots \left(\frac{1}{R}\right)^{1.408}$$

$$D \ldots \left(\frac{1}{R}\right)^{\frac{1}{2}}$$

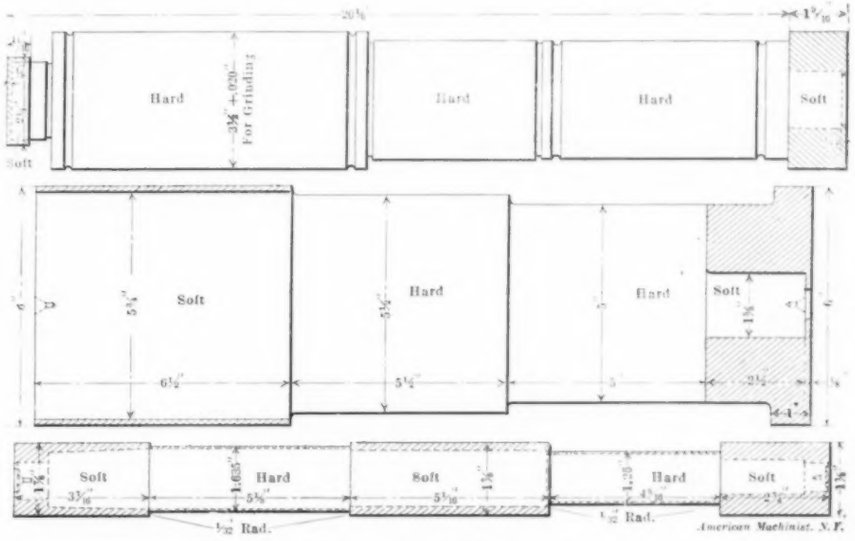
$$E \ldots \left(\frac{1}{R}\right)^{0.408}$$

$$F \ldots \left(\frac{1}{R}\right)^{0.29}$$

To anyone appreciating and capable of intelligently using the table, any explanation of methods of procedure would be superfluous. The table, although somewhat voluminous is essentially simple, as is also the chart which embodies it in every particular. As I would be glad to promote the use of the chart as a quick and handy means of obtaining closely approximate and reliable results, a single example of its manipulation is given under the chart on the accompanying insert page.

## Local Hardening

The three pieces shown in the line cut are samples of local hardening that was done by the American Metal Treatment Company, Elizabeth, N. J. This method of local hardening is by no means new, yet it is one of the jobs which has to be done so often that too much cannot be said about it.




SAMPLES OF LOCAL HARDENING BY CARBONIZING

The three pieces shown are turned, to the lines shown by the outside line of each piece, from machinery steel. After this they are carbonized to the proper depth, then annealed, and then the parts shown by the sectional lines are turned off, after which they are hardened.

By turning off the parts shown by the sectional lines the outside layer which has been carbonized is turned off, and this leaves these parts with the machinery steel exposed. When hardening, therefore, the machinery steel does not harden, and consequently remains soft, while the balance of the pieces, which have a carbonized outer shell, do harden, and this makes the pieces hard in the parts desired and soft in the other places.

The upper piece is a wheel spindle that is turned to its actual size, except at the two ends. After carbonizing and annealing the two ends are turned off, where the sectional lines are shown, and the piece is hardened and leaves the quenching bath straight. The center piece is a locomotive crank pin that is treated in the same manner as the upper piece.

The lower piece has a soft part in the center and at the two ends. This is turned to the outside line shown in the cut, then carbonized and annealed, and then the part shown by the sectional line is turned off and the piece is hardened. After hardening the two hard parts are ground to size.

This brings the piece to its exact size, and the hardened surfaces can be brought to the exact line desired, which cannot be accomplished by any other method of local hardening. It also seems a simpler method than turning them from a high-carbon steel and then binding the parts to be kept soft in clay, asbestos, or other refractory materials and then heat-treating the parts.

## Turbine V. Combined Reciprocating and Turbine Steam Sets

Sir Christopher Furness, M. P., recently had the machinery of his British steam yacht "Emerald" converted so that the three-turbine three-propeller system was changed to a combined high-pressure reciprocating engine and low-pressure turbine plan. It has been rumored that the reduction in the steam consumption was just one-half. Although there was a marked reduction, the saving is hardly as large as rumor has suggested. The following table supplied by Sir Christopher Furness himself, is intended to give figures for comparison. It will be seen that in the first table the steam pressure varied, whereas in the second it was constant at 150 pounds. This makes comparison somewhat difficult, but it is safe to point to the top line in each set of figures, namely, that relating to a speed of 10 knots, when, with a steam pressure of 150 pounds, the consumption figures are 18 and 13 tons. Thus with the converted machinery the steam consumption was rather less than three-fourths the consumption with the three-turbine system. Generally speaking the other figures are of the same order, although the comparison is not in every case quite so pronouncedly to the advantage of the cited combination plan.

| Speed. | Consumption. | Steam Pressure. |
|---|---|---|
| | BEFORE: | |
| 10 knots | 18 tons | 150 lb. |
| 11 " | 23 " | 145 " |
| 12 " | 25 " | 140 " |
| 13 " | 28 " (?) | ... |
| | AFTER: | |
| 10 knots | 13 tons | 150 lb. |
| 11 " | 16½ " | 150 " |
| 12 " | 20 " | 150 " |
| 13.2 " | 22.9 " | 150 " |

## Flywheel Testing Pit at Purdue University

By C. H. Benjamin*

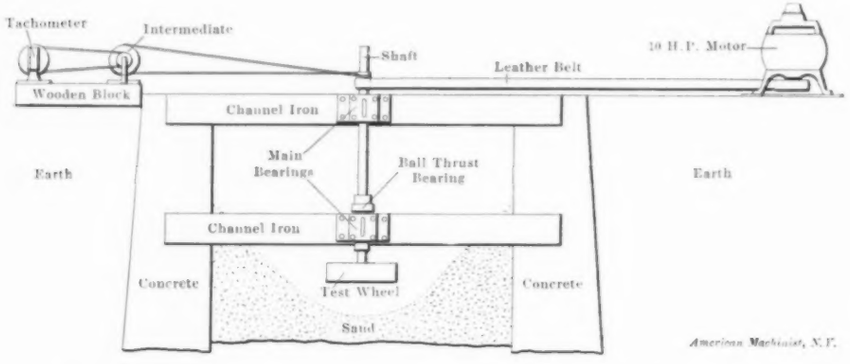
A new plant for the testing at high speed of flywheels, pulleys and other rotating pieces has recently been installed at Purdue University. Some former experiments along these lines have shown the unsafe character of means hitherto employed for preventing the dispersion of the fragments. Following the lead of a German experimenter, who has used a similar device for testing emery wheels, it was decided to use a vertical shaft extending downward into a pit and carrying the test wheel at its extreme lower end. The figure shows the apparatus as constructed and installed.

A pit 7 feet deep and 8½ feet in diameter (see cut) is inclosed by a concrete wall, varying in thickness from 6 inches at the top to 1 foot at the bottom. Suitable steel channels are inserted in piers integral with the wall of the pit and carry the bearings for a vertical shaft 3 inches in diameter. The weight of the shaft is carried by a ball thrust bearing, and it is driven by a pulley at the upper end. The motive power consists of a 10-horsepower direct-current motor, capable of variation in speed from 800 to 2400 revolutions per minute. An open leather belt transmits the power from the motor to the operating shaft. The speed of the shaft pulley is registered by an ordinary pendulum tachometer driven by round cords through an intermediate shaft. This tachometer is calibrated at frequent intervals while testing, comparing each reading with that of a center tachometer applied directly to the top of the shaft. This calibration shows practically uniform readings and no appreciable slip.

Test wheels of any diameter up to 6 feet can be supported and rotated at the lower end of the shaft. Loose sand serves as a receptacle for the flying fragments, and prevents mutilation of the pieces.

As a preliminary to further work on the apparatus, sixteen 24-inch pulleys of various materials were tested to destruction this Spring. When in use, the pit was covered by planking loaded with scrap iron. The experiments thus far made show the apparatus to be convenient and safe. There is little disturbance caused by bursting of the wheels and fragments embed themselves in the sand without further injury. The speed can be readily controlled by the motor, and the tachometer is so located as to be read without any danger to the observers.

It is expected that this plant will be put to further use the coming year for experiments on various types of flywheel joints.




LONGITUDINAL SECTION OF FLYWHEEL TESTING PLANT AT PURDUE UNIVERSITY

## Tools for the Turret Lathe

By C. R. McGahey

Much time is lost in our shop work by not having the tools right and I have noticed the failure of high-speed steel tools that have the tool holders improperly made. One of the first lessons to learn in machine-shop work is the relative position of the cutting edge of tools to the revolving center of the work being turned or bored. This varies with the different kinds of metal, and a tool for turning the outside of a casting will not be set the same as one used for boring out the inside. The position of a tool for cutting steel or wrought iron should be different from one used in turning cast iron.

We recently had an opportunity of making a fair comparison of some of these points. We were machining some large pipe flanges with the tool set as shown in Fig. 1, it being a good high-speed steel.

In boring and threading, the point of the tool would soon burn away as shown in Fig. 2 and the proper speed could not be maintained. The tool being above the center line, the metal had to be forced away as shown in Fig. 1; thus the tool could not clear itself and consequently would vibrate. This is hard on any high-speed steel. The friction from the chip was also much more than it should be, as it had no clearance room and therefore much heat would be generated.

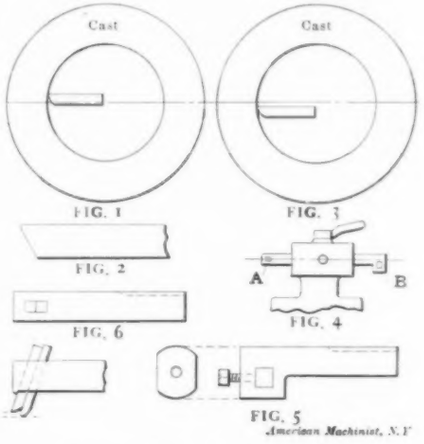
When lowering the cutting edge of the tool below the center, as shown in Fig. 3, and attaining a clearance for the chip, we could turn out twice the work with the same steel under the same conditions.

It is not an uncommon thing to find these conditions in turret or chucking lathes, as the boring bars are made to come central, thus throwing the cutting edge of the tool above the center line, as shown at *A* in Fig. 4.

By changing these bars to the form shown in Fig. 5, we get a holder that will bring the cutting edge of the tool below the center, as shown at *B*, Fig. 4. Another point for consideration is to have the bars as short as possible so as to avoid vibrations.

This same principle is shown in the turning of chilled rolls. A very rugged machine is required, and a simple tool that works well is shown in Fig. 6. A roughing cut and the second or finishing cut can be taken at the same time with this tool. I have used it in boring pipe flanges and similar work.

The rapid and successful production of work on a turret chucking lathe is quite a different problem from that on the engine lathe and consequently different tools are required.




CUTTING TOOLS IN TURRET LATHE

Further evidence of China's awakening is furnished in a contract awarded the Western Electric Company by the Chinese government to supply a complete common battery telephone plant for the city of Pekin. Heretofore almost nothing in the way of telephone development has been accomplished in China, there having been telephones in only a few of the cities, and these largely in the foreign quarters. The contract just closed covers a complete telephone plant of the most modern type for two complete exchanges and amounts to about $150,000.

*Dean of Schools of Engineering, Purdue University.

# Notes on the Design of an Engine Lathe

## An Attempt to Get the Most Lathe for the Least Money, Disregarding Precedent. Some Mistakes Made. The Lathe Is Still Manufactured

BY ENTROPY

Some time ago I was selected to design an engine lathe with orders to get the most lathe for the least money possible, without regard to precedent. The machine was to be cheaply built, of only a moderate degree of accuracy, but was to have an appearance, at least, of solidity of design.

These specifications, of course, prohibited the introduction of mere talking points. The machines were to be sold purely on price and excellence of design. As a matter of history, I shall have to say that the machine is on the market today, with a few talking points added and a much better grade of workmanship than was intended. The design appears to be just now abreast of the times which, seeing that it was made upward of 10 years ago before high-speed steel came into general use, would tend to show that I was ahead of my time. The question of the advisability of adding talking points, in the way of graduated screws, automatic stop, apron such that no two feeds could be thrown in at once, seems to be answered more by the reduction in cost of selling than by increased value to the consumer. That is, with a lathe costing a certain sum and selling at a certain figure, the problem, of course, is to retain as much profit as possible by keeping the cost of selling low. Now a lower-priced salesman can sell machine tools if practically nonessential talking points are added. As a consequence, many makers find it advantageous to include in the design of their standard tools features which will probably be used by but a small part of the users, but which aid in the selling of the tool by making the user think that he is getting something for nothing, while, as a matter of fact, he is simply allowing an inferior salesman to sell him a tool that he may have wanted to buy, but that he likely may have intended to avoid.

### The Headstock

In going over this lathe design I will take the headstock first. The ordinary operations in finishing a headstock are: *a*, planing bottom; *b*, planing in caps; *c*, drilling for caps; *d*, planing crosswise; *e*, boring for boxes and back arms; *f*, drilling for feed rocker, etc.; *g*, planing on to bed in conjunction with tailstock.

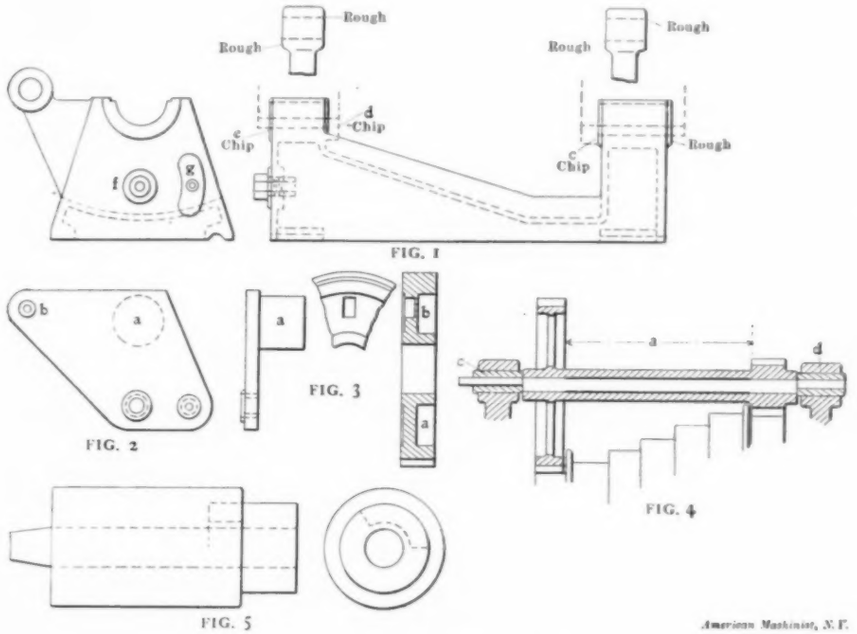
We were able to reduce the cost of *b* considerably by making the depth of the box caps in the head small, about ⅜ inch. I do not know why ⅛ inch is not just as good. The planing crosswise we reduced to planing only the left-hand end of the casting, and later left it out altogether. The ends of the back arms for the back quill gear we left rough, as in Fig. 1. The right-hand end of the front bearing we left rough. The inside ends of both main bearings *c* and *d*, Fig. 1, we had chipped roughly by the scratcher to get under the scale and then swept up by a facing tool in the boring bar. We gave the same treatment to the left end of the rear box at *e*, and then with an end mill faced off the spots *f* and *g* even with the end *e*. We also at the same setting drilled and tapped the hole *g* for the feed-stud bearing. We tried casting this bearing solid with the head and turning the projecting end with an overhanging tool in the boring bar, but had so many castings with blow holes at this point that we found it cheaper to use the method outlined above.

For locating the hole for the stud and the back arms we used the simple jig, shown in Fig. 2. Plug *a* fits in the hole bored for the rear box. Center *b* is swung around until it is as nearly as possible central with the bars on the back arm. (These will vary in hight with the best of castings.) This may or may not bring the stud bearing vertically under the spindle, but we do not care about that so long as the rocker-binder bolt is located right, relative to both holes.

We never found any more satisfactory way to fit the headstock and tailstock to the bed than by mounting both on arbors resting in V-blocks and planing to gage. The only danger of trouble with this method lies with the man who sets up the work on the planer. If he is not careful he will set up his jacks under the castings unevenly, so that any error in fit of the arbors will show in the completed job. We found out about this one time when we were running short-handed. We had a planer hand who was a reformed scraper hand. We had him plane up some heads and tails and told him that he was going to scrape them on himself. He did not take perceptibly longer to do the planing, but he did the scraping in about half the usual time and he did not half try either.

The boxes were fitted as indicated by the dotted lines in Fig. 1, and fastened in place by a countersunk head screw and a substantial dowel pin. Both front and rear boxes were doweled, though there is no good reason for doing it on the front box. We sent one of these lathes off a couple of thousand miles once without any dowel pins. The man that bought it wrote us a year later that the only way the machine could be made to do accurate facing was to stand it on end.

We tried to cast the face gear on the spindle. There was no trouble about the




DETAILS OF ENGINE LATHE DESIGN

casting. It held there all right, but when we tried to square up the hub we simply could not get a casting that was not chilled. Recent developments seem to indicate that if we had taken the casting out of the mold at the right moment we could have had a soft one; but I wonder yet if it would not have been at the expense of having a loose fit on the spindle. We also tried leaving the face *a* of the face gear, Fig. 3, rough and painting it, but we could not get anyone to take the machine that way, even though some that we put in the shop seemed to meet with favor at the hands of the men. We found quite a saving in finishing out the slot for the lock nut by coring nearly through from the back leaving only ⅛ inch to drill and file out, as indicated in Fig. 3, at *b*.

The quill gear and back arms were fitted up, as indicated in Fig. 4. The quill gears by this means are made interchangeable with nothing but a steel rule to make lengthwise measurements. The cone pulley is 1/16 inch shorter than the dimension *a*, Fig. 4. The two gear faces are turned to dimension and the projecting hubs on each end are turned to an over-all dimension to match the quill shaft, as are also the two back-shaft bushings *c* and *d*.

The whole thing, gear, shaft and bushings, we made up together, ready to assemble without fitting. When put together the gear is set to divide the clearance on each side of the cone pulley and the bushings are set up snug. The latter are held in place by set screws which are screwed into holes drilled by hand into each bushing. Inasmuch as there is no end thrust on these gears there is no trouble in making this design satisfactory. It is certainly much less expensive to completely finish work at the lathe than it is to take it back and forth to the erecting floor for final fitting.

Our method of cutting a circular groove in the end of the back-shaft bushing is one that is little used. While it is not original with me, it may be of interest to some. The bushings are cast on end with the grooved end in the nowel. The core is made in two pieces and pasted together for convenience in setting. Fig. 5 shows the pattern with dotted lines to represent the coring. We liked best to leave a little metal all around the central hole, which is to be chucked and reamed so that the reamer will not touch scale at all. This wall, after reaming, is less than 1/16 inch thick and is knocked out with a cold chisel after the reaming is done.

The feed rocker was placed on the outside of the head; it turned on the outward projecting hub of the stud bushing, Fig. 1, and was secured in either of the three positions, for feeding toward and from the headstock and free, by a cap screw with a special head the size of the nuts that secured the change gears in place. To prevent the rocker being swung so far as to make the teeth of the gears mesh too deeply we had been driving two stop pins in the headstock casting. This meant hand drilling and cutting off and fitting the pins. We tried at first drilling and tapping the rocker arc at *b b*, Fig. 6, and screwing in set screws to touch the binder screw *c* when in proper position and then cutting off and riveting them over. The best scheme was to leave the circular slot cored, as shown by the dotted lines, and then filing the ⅛-inch thick section at *d d* until it would bring the gears into proper mesh.

If a man made a mistake and filed too much he could still use the set screws, or he could throw it away, one cost about as much as the other. The rocker studs were made and put in, as shown in Fig. 6, at *f*. The body of the screw at *g* is made a tight fit and the thread loose enough so that we can be sure that the fit at *g* is a good one and establishes the alinement of the stud. Room being scarce, instead of a chuck nut on the end of the stud we gave each one a few raps with a hammer, which riveted it into the thread enough to hold it securely so that we never had trouble with it.

### The Tailstock

The tailstock of a lathe is so simple a proposition that there was hardly any opportunity to cheapen it. We tried making the barrel around the spindle cast on Western style (now Eastern as much as Western) and left rough. We also tried making the cap or bonnet rough and painting it. This was afterward changed and polished, but not because of any pressure from customers.

The question of hand wheels versus 3-ball crank was one that vexed us greatly. So far as we could discover we could use either and have our customers satisfied on anything less than 24-inch swing. We, therefore, used hand wheels on 24 inches and over, and after discovering that we could buy 3-ball cranks for less money than we could make hand wheels we used the cranks. I always thought there was some mistake about this for I believe that I could turn out a 9-inch handwheel in less time than I could true up a 3-ball crank of that length and polish up and fit a handle to it.

The joint between the tailstock proper and the cricket on which it stands we made, as in Fig. 7, so that the thin projecting ribs could be chipped and filed in short order to allow of a neat finish between the two parts with a minimum expense.

### The Carriage

The carriage offered very few chances for saving in cost. We saved a trifle on planing the top surface by cutting back the ends of the wings into little pockets from 3 to 6 inches long, on different sizes and leaving them rough. This scheme has a real value in that the pockets serve to divert the chips when brushing off the rest and keep some of them, at least, from resting on the V's. The joint between the compound slide and the swivel we made the same as that between the two parts of the tailstock so as to give us a neat finish without much expense.

The tool-post design is very little different from common. The tool slot is left round ended. After various attempts at milling this slot we finally rigged a jig, Fig. 8, in which we clamped the tool post and drilled a row of holes spaced to leave about ⅛ inch of metal between. Then we slid the tool post along in the jig until

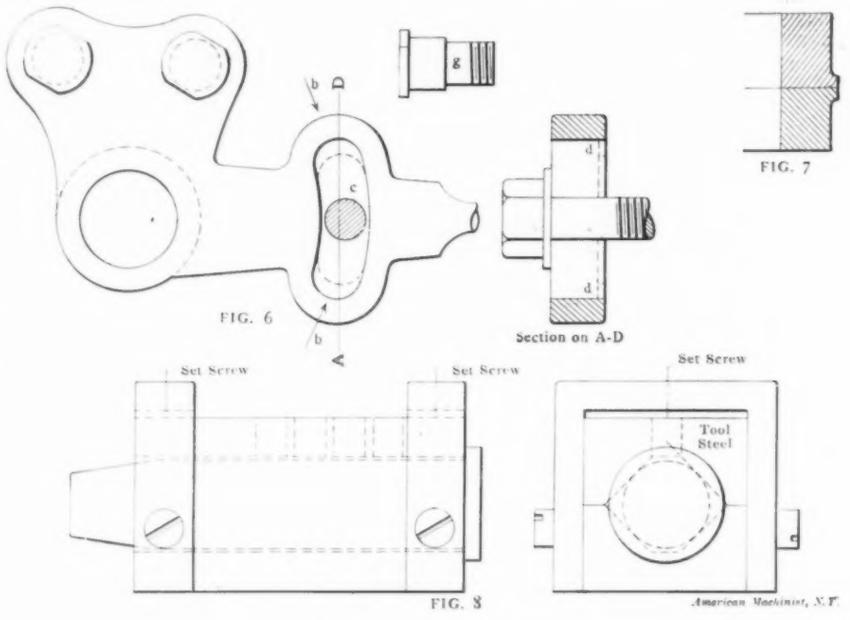



FIG. 6 Section on A-D FIG. 7

FIG. 8

DETAILS OF ENGINE LATHE DESIGN

the point of the drill was central with the spaces between holes, and drilled again. This left only a little metal to be gotten rid of and that was removed in short order by a coarse file in the hands of a husky laborer, leaving the final smoothing up for a man who knew how to use a file. To hold the posts while filing we used the holder, Fig. 9, which was in turn held in a vise. The cut is self-explanatory.

The rockers under the tool we made of a steel casting, like Fig. 10. We held this in a chuck and turned the outside to the required diameter and then sliced it up with a cutting-off tool just as the piston rings are cut off. After that we sawed up each ring into six or eight rockers and faced the top off and checkered them in the shaper.

The shoe under the tool post, Fig. 11, was quite a problem until we got the shop next door to take a bar of wrought iron large enough to finish to the width and thickness of the required shoe, and punch a row of holes in it. We took it over to the blacksmith shop and flattened it down and then planed it up to size. Then the man on the heavy drill ran a 3-lip chuck drill through each hole and then put a counterbore down to a fixed stop, which consisted in making the guide on the counterbore just long enough to touch the drill table when the counterbore was deep enough. All there was left to do was to cut the bar up on a power hack saw.

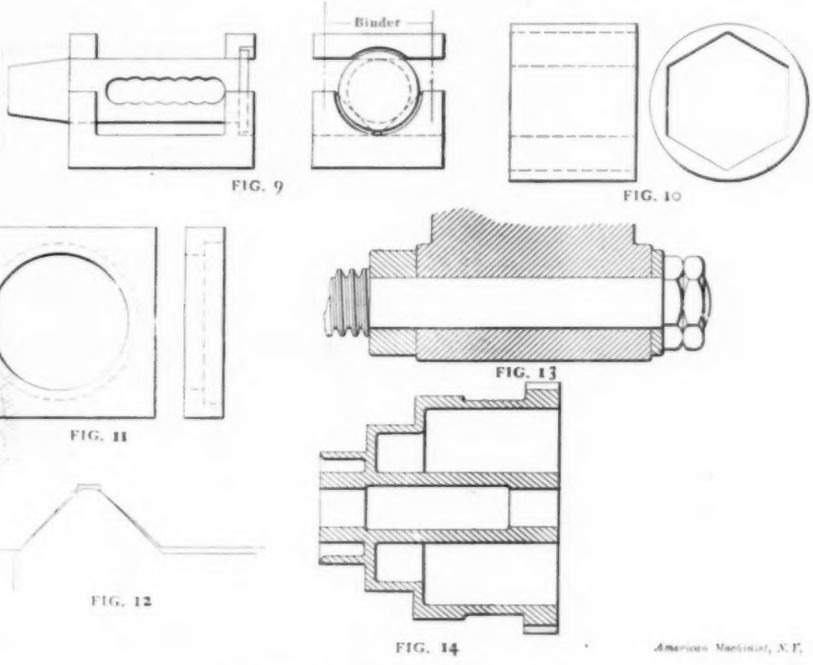



FIG. 9 FIG. 10

FIG. 11 FIG. 13

FIG. 12 FIG. 14

DETAILS OF ENGINE LATHE DESIGN

### The Bed

The lathe bed offered few chances for saving. Two things we tried and discarded, one was slanting ends with the legs set under. One would naturally think that these "boat-shaped" beds would weigh less than the regular square-end ones, but we were unable to get satisfactory beds from the foundry that did weigh less. On the score of beauty we could see nothing to favor in the new style and there was no difference in the cost of machining or fitting up.

We also tried using one V and one flat way for both carriage and tailstock. We found no gain in the planing and usually a loss in scraping. With the four-V bed all that is necessary is to plane the top of the pairs of V's to the same hight and then plane down to the correct angle and to gage, keeping the tops of the two V's of equal width, then both V's are really of the same hight. With the single V and flat way the planing became more serious because a slight error in the hight of the flat cants the bearing on the V to make it bear on the top of one side of the V and the bottom of the other, see Fig. 12. There are two chances to get this thing wrong, one on the bed and the other on the carriage. We usually got both a trifle off and the scraper had to do the rest.

### The Feed Mechanism

The feed mechanism is another place where we had to guess the second time before we got down to hard pan. It struck us at first that it would be cheaper to use a splined screw instead of separate rod and screw. We found that the cost of the feed rod and boxes just for material was pretty small, on the average being about 60 cents for an 18-inch lathe. We found that it took longer to spline a screw than it did a rod on account of the danger of catching on the thread and tearing out. We found that the cost of lining up a feed rod on a lathe was equal to the cost of lining the split nut in the lathe apron to the worm, and we found that the cost of filing every thread of the lead screw so that it would not cut out the nut covered all the rest of the expense. Since customers prefer the separate rod every time on small lathes, we stuck to the separate rod and screw.

One of the expensive things, as usually made, is the thrust bearing for the lead screw. Expansion under varying temperatures makes it necessary that the thrust in both directions be taken at one bearing. We could see no reason why it might not be taken at the tail-end bearing rather than at the head end and thereby save the expense of welding a collar on the rough bar. We, therefore, used the construction shown in Fig. 13, of a collar of cast iron driven up against a slight shoulder and then a loose collar or washer with two thin chuck nuts. The tight collar should be faced in place after being driven on. The loose collar should either be very well made, a good fit and square on both faces, or else should be a thin washer and loose enough to draw up parallel to the tight collar.

For a feed mechanism we did want something that would give us more than the regulation through belt feeds, even if we were not after talking points. The solution, while it is doing duty on some hundreds of lathes, is likely unfamiliar to many of your readers. It was simply to put the feed cone that usually does duty on the feed stud on the intermediate gear instead. The thing, as used, looks more as if we put the intermediate gear on the cone pulley. See Fig. 14 for the cross section of the two combined. The result is that for every gear that we can put on the feed stud we get three belt feeds, a range to suit every one. Since our gear plate calls for a 20-tooth change gear on the stud the larger part of the time we figured on giving the New England feeds of 40, 60 and 80 per inch with that gear. If a man wanted a feed of 20 to the inch he could use a 40-tooth gear on the stud, etc. There was also the advantage that an endless belt could be used since the intermediate gear could be set, and then when the sweep or rocker was pulled up into place we had a good leverage to pull on to stretch the belt.

---

Experiments in several French cities with rubber-asphalt roadways covering a period of six years are reported to have shown very satisfactory results. Rubber asphalt is claimed to be more plastic and more adhesive than pure asphalt and resists higher temperatures. This product, which is manufactured under a patented process, permits cold applications of the asphalt, which are said to possess all the advantages of hot compressed asphalt without its drawbacks.

# The Ideal Piston Pin

By Horace L. Arnold

The more common practice in piston-pin form is to seat the piston pin in piston-boss holes bored accurately at right angles to the piston axis, and hold the pin in the piston by screws at one or both ends, these pin-retaining screws passing through one wall of each piston boss commonly, though a great many different forms of pin-holding screws have been used. Upon this pin, fixed in the piston the connecting rod is hung. Common practice is to harden and grind the piston pin, which is sometimes made hollow clear through or part way through, and bush the top end of the connecting rod with a bronze sleeve forced into the rodeye, the bushing being a close sliding fit on the hardened piston pin. Lubrication of the rod and pin joint is by a catch-basin or cut in the top of the connecting-rod top-eye, the catch-basin or rod-end top cut catching the oil mist which fills the crank box and the entire interior of the piston. The construction so far described makes the rod rock on the pin fixed in the piston.

Another arrangement fixes the pin in the rodeye and leaves the two ends of the pin projecting from the rod on each side, free to turn in the piston hubs, which are sometimes bushed with bronze and are sometimes not bushed at all, making the pin ends turn in plain holes bored and reamed in the piston bosses. Where the rod rocks on the pin the top rodeye, brass bushed, is made to give as long a bearing on the piston pin as can be safely had. It is the more common practice to make the rod rock on the pin and hold the hardened and ground piston pin in the piston bosses with some form of screw.

Besides the piston-pin forms and the pin-holding screws specified a very considerable number of other pin-forms and pin-retentions are shown, almost every conceivable variation being employed.

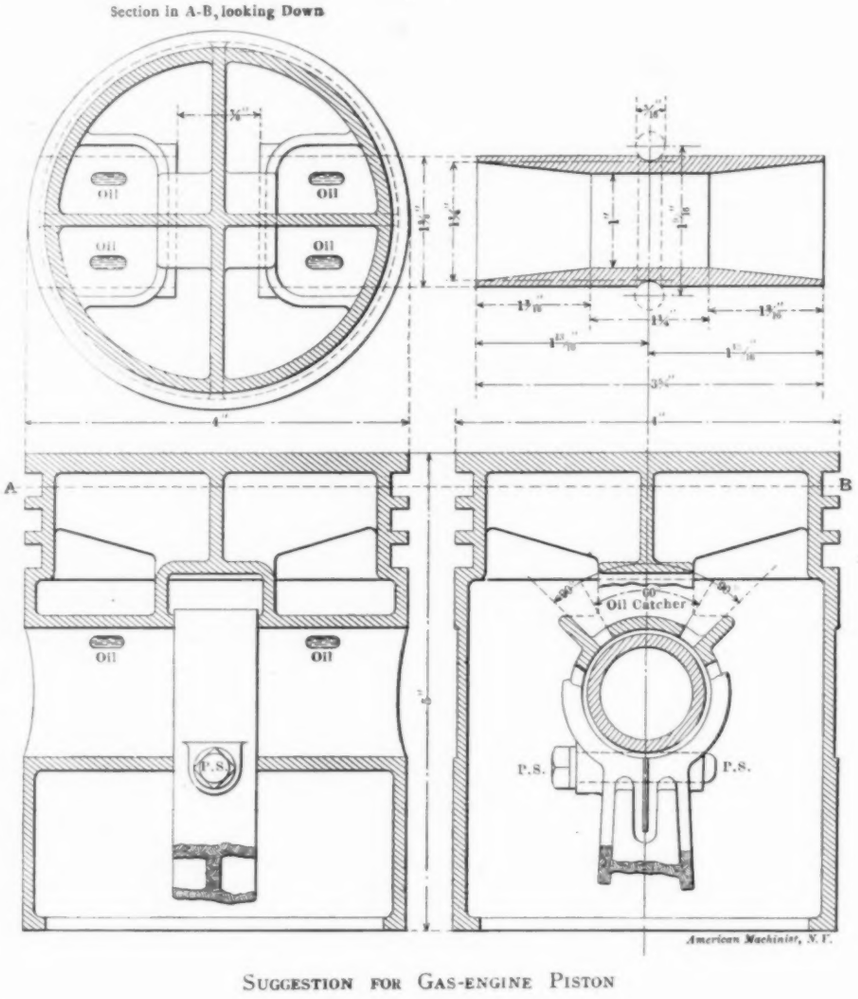
The piston-pin diameters as fixed by different designers vary greatly, and taken all through the 1909 piston and top rod-end practice is far from indicating agreement in the views of car-motor designers at large.

There seems to be very little trouble with the lubrication of the rod on the pin or of the pin ends in the piston bosses: probably the splash-pool oil is thrown up in the piston cavity so that it strikes against the underside of the piston head and falls back into the catch-basins in the rodeye or the piston bosses equally well, leaving the designer free to choose his own forms for the pin and piston hubs and top rodeye, so far as oiling is concerned.

The ideal piston pin is that which best takes the piston work load, best transfers this work load to the connecting rod, is most reliable, that is to say, is least likely to suffer relative displacements by work, is most durable, and, last of all, costs the least.

A hardened and ground tool-steel pin taking a bronze bush forced in the rodeye, ordinary practice, cannot be classed as a low-cost production, and the designer is pretty sure to save what he can in weight and cost by reducing diameters as much as he dares.

The fact is that in a 4-inch diameter piston the pin can be any diameter up to say 1⅝ without taking up room needed for anything else, and with a sufficient bearing area a soft-steel pin working in the gray iron piston bosses will have as much endurance as a much smaller diameter hardened and ground pin working in a bronze bush.




Suggestion for Gas-engine Piston

The writer recalls being shown a Reo piston pin, 1⅜ diameter of soft-steel tube, by R. E. Olds himself, at the Lansing shops, which had had a long tryout on the road, and was not a carefully finished job at first, as was plainly shown by the unequal rubbing marks on the pin surface. This pin was in excellent condition, decidedly improved, in fact, by the work it had done. No information was given as to whether the piston bosses were bronze bushed or not, and the writer does not know whether the Reo adopted and is using this large diameter, tubular, soft-steel piston pin or not, at present.

Soft steel works well in gray iron bearings, and a piece of stiff Shelby steel tubing, within 1/1000 of nominal diameter, is a low-cost stock. Such a tubular steel pin can be very cheaply reduced to truly cylindrical form by grinding and can have the superfluous stock removed from the inside to make the bore taper at each end at small cost. It does cost more to bore and ream the longer piston bosses to 1⅜ diameter than it would cost to bore and ream shorter piston bosses to say ⅞ diameter, but only a very little more.

The ideal piston pin shown in the illustration given herewith is 1⅜ diameter, Shelby steel tube, 1-inch hole, 3/16 walls, pin bore tapered by boring or reaming at each end to make the wall 1/16 at outer ends. It is not the writer's intention to here assert that a 1⅜-inch diameter pin is best for a 4-inch diameter piston, but only to show that this ample diameter gives no inconvenience, and might readily be increased, though it is much greater than common practice. With a connecting-rod body ⅞ thick the pin ends can have 1⅜ inches bearing length at each end, 2¾

inches total bearing length and 1⅜ pin diameter; much more, probably, than is needed to permit a film of lubricating oil to separate the pin and piston-boss walls at time of the heaviest load and so insure the longest life of a plain bearing.

The illustrations, two vertical sections and a sectional plan of a 4-inch diameter piston, a 1¾ diameter piston pin and the construction of the top end of the connecting rod, split downward and pinched on the pin with the 5-inch pinching screw, *P S*, are all drawn to scale. The four head braces go down to a bridge over the rod end, which unites the inner ends of the piston hubs, so that the ribs and bridge together transfer the piston load directly to the piston pin seat and to the pin itself. The ribs taper upward from the bridge to the piston walls and so leave the oil catchers fully exposed to the oil mist. The oil catchers are very large, and the oil holes, ⅜x3/16, are not in the top middle of the pin bosses, but have their side lines 30 and 45 degrees from the center, thus leaving solid metal all the way on top of the pin seat where the load is transferred to the pin. The oil holes are very large and are cored through to the pin-seat core, as the oil holes are not large enough to interfere with either boring or reaming of the pin seats.

The parts are broken away in the vertical cross-section of the piston so as to show the oil-catcher construction.

It will be noted that the piston machining is most simple, and that the piston pin is certain to be flooded with oil, while the rod-end construction is easy.

The pin-retaining screw groove, 1/16 deep, 5/16 screw, 30 threads per inch, permits very ready assembling and disassembling. The solid rod body is split below the top rodeye with no loss of rod strength and the ⅝ screw, fine thread, pinches the rodeye on the pin securely, and if the screw is a close fit in its tapped seat in the rod body there is no probability whatever that the screw will shake loose as it is turned down hard on its head flange. This construction saves all hand fitting on the piston and avoids forced fits, while the assembling is easy and infallibly correct because the one thing that the ordinary workman never fails to do is to turn a screw down as hard as possible. The one retaining screw is readily reached with a flat wrench or with a shanked box wrench through a hole bored to pass the wrench in the piston wall, which would do no harm even if the lubrication were by an oil groove in the cylinder.

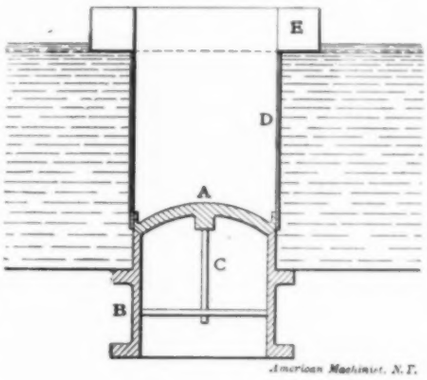
The writer claims little originality for this piston pin. The pin retention in the rod end by the pin groove and split-rod body and pinching screw below the rodeye, and the tapering of the pin bore at the ends are original, but may have been shown before. The piston itself has a head 3/16 thick and is otherwise ⅛ thick everywhere; ⅛ is ample for the pin-boss wall thickness, and may be thought too much for some parts of the piston wall by some designers. The internal bracing of the piston head may be of greater depth than is needful, but as before said, the principal object of this story is to show that a very large diameter, soft-steel piston pin can be placed without any inconvenience whatever, and that fixing the piston pin in the rod end is much less costly and more convenient and better in every way than fixing the pin in the piston bosses.

## A Homemade Semi-balance Valve

By R. A. Anderson

We had a large water drum with a 6-inch discharge pipe and it was important that this drum should not fill beyond a certain point; so the valve had to be fairly sensitive and also automatic. Being quite a distance from the supply houses, we decided to make a semi-balance valve and thus save time and money, and Fig. 1 shows the results.

The cast-iron body is shown at *B*, with the brass float *A*. This float has a stem




A Homemade Valve

*C* working in a slot, in a strip of iron, to center the valve. To relieve the pressure on the float, caused by the weight of the water, a sheet-tin tube water joint was soldered on, and at the top of this was soldered the air float. The line cut shows how it operates, and it answered the purpose as well as an expensive balanced valve would do aside from the time saved.

According to the *Nautical Gazette*, leaky gasolene tanks can be temporarily repaired by the use of common yellow soap. Gasolene will not affect soap and if the latter merely is pressed into a leak the opening will effectually be stopped up. In the absence of shellac, soap is an excellent article to use in making up gasolene-pipe joints.

## Echoes from the Oil Country—Improvements Not Always Appreciated

By W. Osborne

The job was not a nice one but the man who came along with it was one who talked in a pleasing way. He had come a long way, more than twenty miles, across the country to reach this shop because he had heard that good work was done, that special efforts were put forth when a man was in a hurry and that a fair price was charged, besides he had a job that he must take back with him.

This job proved to be the cylinder of a sawmill engine. It had been 12x16 inches originally, which was a long time ago, but had worn and been rebored until it was about 12¼ inches diameter and in need of reboring, but the place where it most needed repairs was in the steam chest.

The valve seat was worn down so that the ports had lengthened out and finally got down beyond anything provided in the original plans of the desinger. The valve was a single D-valve moved by a fixed eccentric. The steam distribution must have been very bad even with things in good shape.

After looking things over it was decided to make a false valve seat and new valve, and to rebore the cylinder and put in a bull ring with two snap rings.

The valve part of the job was put into the hands of a young man who had lately been working for a man who built engines and he found that he could push the ports in the false seat together so as to get better steam distribution. Unless he did this he could not get lap enough on the valve, as the steam chest was too short to allow a long valve to travel without hitting. As nearly as could be told from the old parts the valve had about the same lap inside that it had outside, and that was the usual practice.

Many of these old timers seemed to have been patterned after locomotive practice and it was very gratifying for a sawmill fireman (incidentally he was engineer, too) to be able to boast that his engine had an exhaust like a locomotive. In the more modern engine shops this had been changed until the exhaust side of the valve had very little lap.

This job had been brought to the shop shortly after seven o'clock in the morning. While a cut was being run through the cylinder a sketch was made and given to the patternmaker. That evening a valve and seat were cast in the foundry. The next day they were fitted and the seat secured to its place in the steam chest with brass screws. After fastening a cut was taken over it. The balance of the job had been done but according to good practice the valve and seat should be scraped

together, and there was another little point that had not been attended to. To get in a seat of reasonable thickness it had been necessary to leave very little clearance between the valve stem and the valve.

The hole in the steam chest through which the valve stem worked was worn out of shape and it was not easy to get a very accurate measurement. It might be necessary to file the valve so as to let it have a little slack between the valve stem and the cylinder. Chipping strips had been left so that it could be done if necessary and the young man doing the work wanted to take some off of them. By the time the job had progressed so far it was evening of the second day. The owner of the job had his team standing at the door. It would be an all night's job to get to the mill and every minute was precious. All mechanics know that it would be very easy to see what was needed when putting the engine together and to do what was needed. The needed change in valve setting had been explained and seemed to be understood. It had been explained that it would be necessary to watch things for a few days because the valve scraping had not been as well done as it would have been with more time available. Everything seemed to be understood and away went the man.

In such a rush had this job been done and in such a hurry was he to get away at the earliest possible moment that he did not stop to have the cost figured up but directed that the bill be mailed to him. It amounted to $23.84. About two weeks after this a letter was received. It calmly and judiciously set forth that the job done had been one to make even sawmill mechanics blush. Nothing had been right. It had been necessary to file the bull ring before the piston would go into the cylinder and the valve was even yet groaning and making the eccentric rod shiver. Evidently the whole planning of that job had been erroneous. With things in the good old fashioned way that engine had run for more years than it had run days since the change. However, feeling that he was somewhat to blame for not knowing better than to take an important job to a shop where they were so incompetent, he would pay one-half of the bill and not any more except after a law suit.

This letter came in the morning mail and after reading it the owner of the shop handed it to the young man who had been in charge of the job and who had done most of the work on the planning and fitting of the valve and false seat. It is likely that the owner with his years of experience knew somewhat nearly the facts after reading the letter but the young man took it at its face value and to say he was mad was putting it mildly.

Without a word he handed it back and began to take off his overalls.

"What does this mean?" asked the owner in surprise.

"It means that I am going to see that job, if it is the last thing I ever do," was the reply.

The owner tried to explain that it would not be necessary to take any such action, that the amount at issue would not justify it.

"This is my affair now. I am going at my own expense and on my own time and if you don't want me to work for you when I get back you don't have to have me, but I am going and that is all there is about it."

Seeing his determination the owner told him where he would find the store which this man owned and where he could find the location of the mill, even if he did not find the writer of the letter.

Early in the afternoon the young man was in the store listening to the talk of the millowner. He said very little except inquiring the way to the mill. A boy who worked in the store was sent with him to show him the way. This boy explained what a man his master was to make things go, and how he was putting the mill on a paying basis and making the men do a good day's work, etc.

At the mill it was found that the engine was not in good shape. It was certainly working hard and making hard work of it. To help out the bolts a piece of timber was wedged from the steam-chest cover to a beam and another one from the cylinder head to another beam. Even with that help both joints were leaking. The steam gage on the boiler showed 100 pounds and the throttle was wide open. To furnish lubrication for the cylinder there was an old-style tallow cup that would hold about 4 ounces. It was tapped into the side of the governor body. The fireman explained that it was put there so that it could be filled. There was a valve made to be closed when the lubricator was being filled but this valve leaked so that it was necessary to close the throttle valve and shut the engine down to fill it. The worst sin that a man could commit around that mill was to stop it even for a minute. He also explained that the cylinder had arrived in the night and had been put on without any lining up. It had been found that it did not line with the crosshead and the piston bull ring had been filed so that things could be gotten together. The valve should have been filed to let the stem down a little farther, but instead of that it had been sprung enough to connect up. The eccentric had been rolled around so that the steam was admitted at the right time. It had taken until morning to get it going and it was allowed to run along without any load until the fireman and the men helping him had gotten breakfast. It then had been put to work pulling the mill and had run twelve hours a day until the Sunday following. On being examined the cylinder had been found somewhat cut and the valve and seat quite badly cut. The fireman could do very little except report their condition, and the letter resulted.

Getting back to the store the young man expressed himself in very plain terms. The millowner defended his position in the matter by referring to the practice on a little narrow-gage road that ran near. The master mechanic of this road was a friend of his and had posted him on all that was good practice and was willing to go into court in his behalf, etc.

Rather than have or make trouble the bill was paid but so strong was this man's faith in his friend, the master mechanic, that he believed that all trouble would have been saved if the job had been planned and done by him, and so strong was the faith of the master mechanic in his own judgment that he was persuaded to remodel the job. He made a new pattern for a valve and seat, for he felt sure that the starting of the trouble was in the design which could not be good as it differed from his locomotives and the exhaust came out easy instead of barking. To get the castings needed the patterns were brought to the foundry which had done the original job. The young man grinned when he looked them over and he grinned some more when he heard the confident boast of the master mechanic as to how slick he was going to fix things. He had seen that mill under regular operating conditions while the master mechanic had not. Several sets of valves and seats were cast and finally a request was made to cast a set from the patterns which the shop had made and put in.

"The fireman says," explained the master mechanic in giving the order, "that it was easier keeping up steam with that set than with any of the others, and I am going to put them in and then I am through with the whole matter."

"Have you been able to get a fair price out of that man for your work?"

The question did not seem to be a welcome one and he hesitated for a moment and then said, "I'll just tell you the truth of the matter. I was so blamed sure that I could fix him up that I have never asked him for a cent yet. I have machined up the castings at night myself and put them in nights and Sundays, and I have paid you for the castings. Now I am going to make the job as near like you folks had it as I can and then let it alone, and if he will never mention his mill to me again I will be satisfied to never mention my work to him."

---

The following reference to the construction of a locomotive is worthy the reporters of the present day. It is taken from a publication in 1826, and reads: "The locomotive engines are made of thick sheet iron, and are obviously of the high-pressure kind."

## Some Features of the Premier Shops

The building of automobiles is fast becoming a manufacturing proposition, so that there is a greater uniformity in the machines and methods used than was the case a few years ago. At the plant of the Premier Motor Manufacturing Company in Indianapolis, Ind., we find in most cases the employment of good machine-shop methods with a few special tools designed to meet requirements not covered by the regular tool equipment.

They are one of the few builders of automobiles who are using cast-iron crank cases, maintaining that they are enough stiffer than the aluminum to warrant the extra weight, which is not as great as might be supposed, owing to the thinner walls which can be used.

In Fig. 1 is seen the fixture and the method used in boring these crank cases under an upright drill. The fixture is set on the base of the drill, holding the crank case in a vertical position and driving the boring bars in their proper places.

### Grinding the Valves

The grinding of valves by hand is not only slow, but also very tiresome to the operator, and in this case an old drill press has been converted into an automatic valve-grinding machine, as shown. The cylinders are held on the fixture on the drill-press table and the spindle driven by the friction disks mounted on the horizontal shaft. The spindle is spring-supported and arranged to automatically lift the valve from its seat, between reversals, the grinding spindle being driven first one way and then the other by having alternate portions of the friction surface of each disk cut away. The automatic lifting device is shown on the side of the arm which supports the spindle quill. This machine does very efficient work and does it very rapidly and at a low cost.

The valve cams used on the Premier cars are made independently and pinned into place on the cam shaft. These are finished by grinding with an ingenious attachment to a Norton grinding machine by which a master cam insures grinding in relation to the grinding wheel so as to produce an exact duplication on every

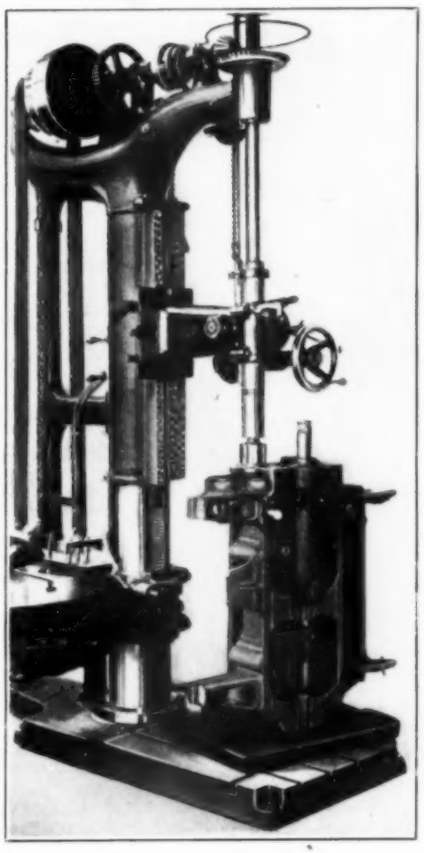


FIG. 1. FACING AND BORING CAM SHAFT HOLES

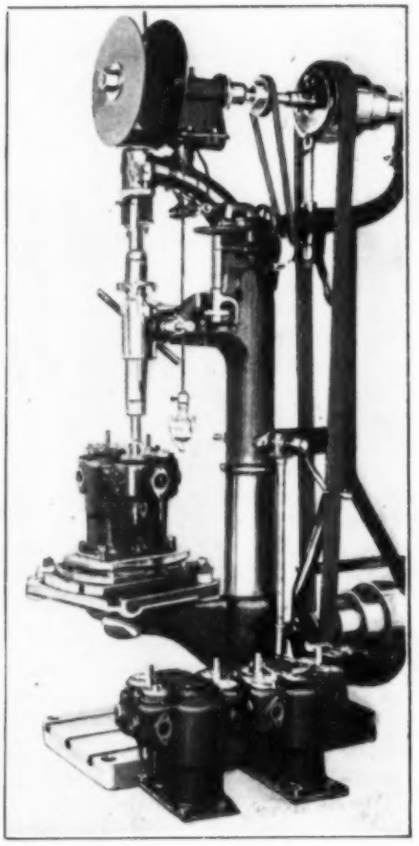


FIG. 2. AUTOMATIC GRINDING MACHINE MADE FROM AN OLD DRILL

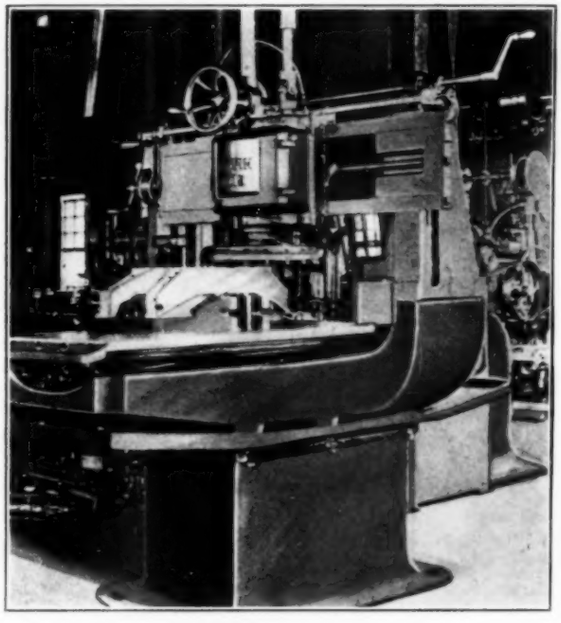


FIG. 3. FACING TRANSMISSION CASES WITH 16-INCH FACING CUTTER

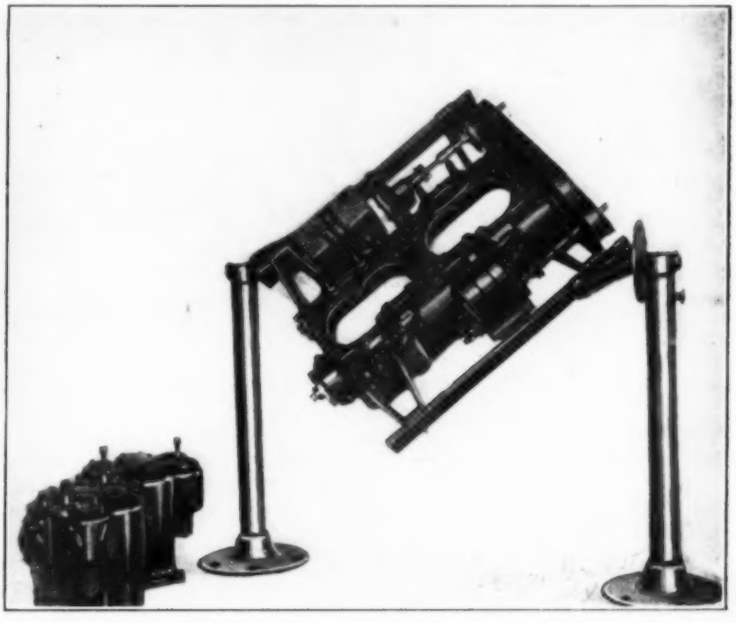


FIG. 4. MOTOR ASSEMBLING STAND

cam. Nearly all surfacing work is done by milling as is usual in automobile shops, and Fig. 3 shows a job of this kind being done on a large Garvin milling machine. The milling cutter is of a somewhat unusual type consisting of a heavy-spoked cast-iron wheel with the arms dished to one side, as can be seen, and the cutters inserted in the rim where they are held by set screws. The cutter shown is 16 inches in diameter, and this form has been found particularly useful in work of this kind.

In assembling the power plants of an automobile it is usually necessary to get at all parts of the mechanism, and it becomes quite a problem to know how to hold them during this operation. In the assembling stand, or other devices usually found, it is difficult to get at the bottom of the crank case, and, where the whole engine is set in a cradle the supports are very apt to be in the way of the workman's feet and legs.

### A Novel Assembling Stand

The assembling stand, shown in Fig. 4, seems to embody more good features than any we have seen, and consists of the two uprights which are made of heavy piping screwed into a large base or flange, and having a top carrying a trunnion and the flat bars, shown on each side of the crank case. These are at the same angle in both cases so the flat bars will always be parallel to each other, and these bars, together with the trunnion, are simply bolted to the sides of the crank case and the whole thing is mounted on the upright shown. In this position the crank case can be placed horizontally while the cylinders are being put into position and can then be swung at any angle desired, so as to get at the pump, cam-shaft gears, or the bottom of the crank case with equal readiness. The index plate on the right trunnion, together with the pin in the upright allows the whole thing to be held in any position desired. This is an extremely simple device as well as being very effective.

A portion of the motor-testing room is shown in Fig. 5, each engine being mounted in a testing block in about the usual way, the exhausts all being connected to a common outlet above, and the portable crane at the back showing how easily they can be handled when proper appliances are at hand.

Cylinders are finished by grinding in a Heald cylinder grinding machine, while the pistons are finished in the same Norton grinder that grinds the cams by the aid of the special attachment mentioned.

F. H. C.

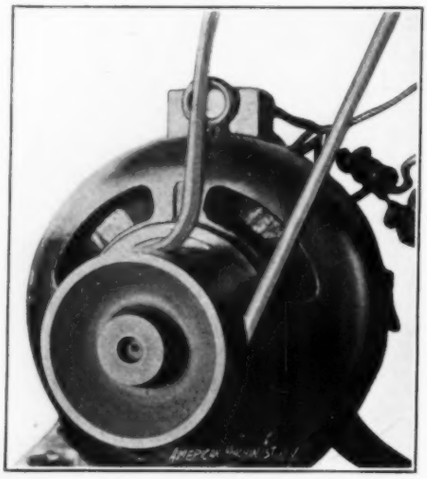


FIG. 1. 5-HORSEPOWER MOTOR AT 1000 REVOLUTIONS PER MINUTE DRIVING THROUGH "WHITTLE BELT"

FIG. 2. SHOWING SLACKNESS OF STOPPED BELT

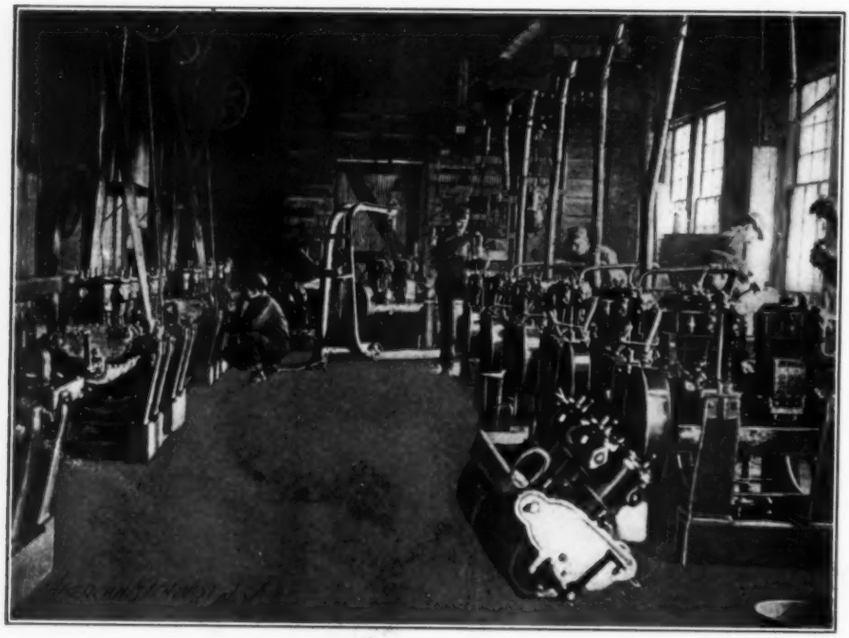


FIG. 5. MOTOR-TESTING ROOM

## An English Belt Drive

By Frank C. Perkins

The accompanying illustrations of an English belt drive are of interest in view of the extraordinary curves taken by the slack side of the belt when running. The belt is a Whittle leather link of ⅜ inch as utilized in the municipal electric station at Warrington, England. The illustration, Fig. 1, shows a five-horsepower motor operating at a speed of 1000 revolutions per minute, driving through a Whittle leather link belt showing the belt running, the direction of rotation being clockwise. The pulley is 12 inches in diameter and the pulley groove where the belt runs has a comparatively dull surface, showing that friction and slip are very small. The illustration, Fig. 2, shows the belt at rest, giving an idea of the slackness; it is stated that the belt has been in use for four years without being touched in any way. The photos for these illustrations were supplied by F. V. L. Mathias, borough electrical and tramway engineer for the electricity department of the county borough of Warrington, England.

While the daily papers are dilating on the successful experiments with divided axles under railroad cars on one of the Western roads, they seem to have entirely overlooked the fact that exactly the same results can be accomplished by the use of loose wheels on the car axle, and that this has been tried and abandoned several times. It is used almost exclusively on mine cars and on industrial railways where the curves are very sharp and the rail friction due to the outer wheel traveling farther than the inner, is a considerable item. This construction has never found favor on standard railways, but it is certainly to be preferred to almost any scheme of a divided axle which can be imagined.

# Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

## WE PAY FOR USEFUL IDEAS

### Model vs. Sketch

While at a certain factory recently I noticed the superintendent carrying in his hand a peculiarly shaped piece of wood, evidently formed with a band saw from a block. Wondering what this piece of pine could be for I satisfied my bump of curiosity by asking.

"That," said the superintendent, "is a *drawing* for my forge department. You see it is this way. I sometimes want forgings made of irregular shapes, and my men can so much more readily understand what is wanted if I cut a rough model rather than make a sketch."

The scheme is one that can be used in many instances, for often mechanics are not quick to comprehend a rough sketch, if indeed some of them can do so at all, although they are competent men in their line. When a band saw and a few other woodworking tools almost always found in large shops, are available, it is only a short job to cut out a model for many things required to be made and with something tangible to work from the desired end is usually more quickly attained by the mechanic.

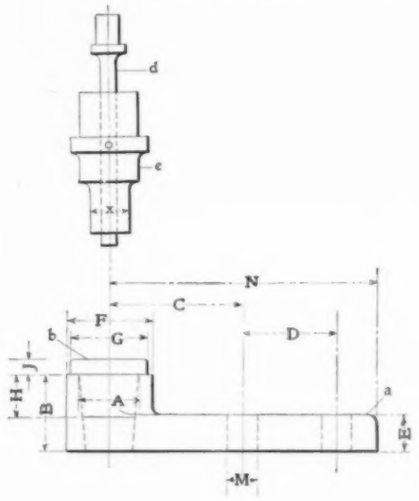
Detroit, Mich. J. C. A.

### Press Tool Standards

Fig. 1 shows a simple, yet durable, punch and die outfit which for small work can be easily changed from one job to another without changing the holders providing the diameters of the blanks are the same or nearly the same. The holder *a* is a drop forging. The distances between the centers of the screw holes and the die are made to a standard jig. The die *b* is of tool steel hardened and ground, the taper of the dies and holders being 3 degrees. The drawing punch *d* is of tool steel hardened and ground, and *e*, which is the blanking punch, of tool steel, is also hardened and ground on the diameter *x*. The punches are secured in their respective holders by square-head set screws.

The dies are forced into their holders, screwed to the bolster plate and the tops of the dies are ground in a surface grinder so that the metal will feed over them easily. In like manner, the blanking punches are ground, while the drawing punches may be left as they are without grinding.

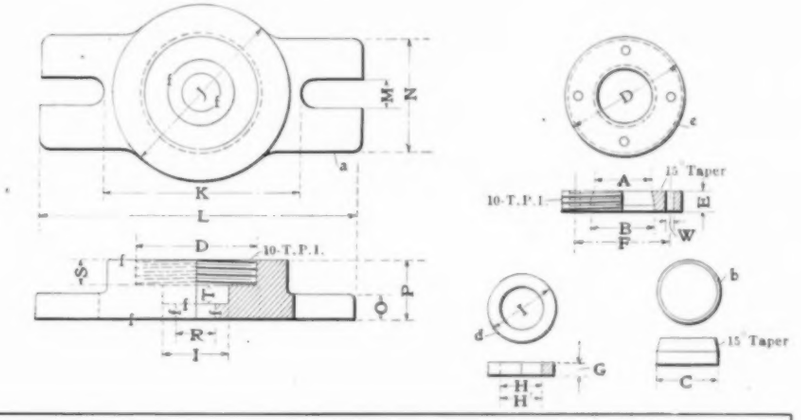
Fig. 2 is a set of tools which may be used for work too large to be done with the tools shown in Fig. 1 These tools can be used for cutting and drawing, drawing, or drawing and redrawing. The die holder *a* is of cast iron finished as indicated; *b* is the first die of tool steel hardened and ground in which is cut the shape of the blank, or the diameter of the drawn shell. These dies have a 15-degree taper on a side. For cutting and drawing, or drawing, these dies bottom on a steel ring *d* which may or may not be case-hardened. For redrawing, another ring of




| A | B | C | D | E | F | G | H | J | M | N |
|---|---|---|---|---|---|---|---|---|---|---|
| ¾ | 1 | 1¾ | 1¼ | ½ | 1⅛ | 1 | ½ | ¼ | ⅜ | 3½ |
| 1 | 1⅛ | 1¾ | 1¼ | ½ | 1⅜ | 1¼ | ¾ | ¼ | ⅜ | 3½ |
| 1⅜ | 1½ | 1¾ | 1¼ | ⅝ | 1⅞ | 1¾ | 1 | ⅜ | ⅜ | 3½ |
| 1⅝ | 1⅞ | 2 | 1½ | ¾ | 2⅛ | 2 | 1¼ | ⅜ | ½ | 4 |
| 1⅞ | 2 | 2 | 1½ | 1 | 2⅜ | 2¼ | 1½ | ½ | ½ | 4 |
| 2⅛ | 2 | 2 | 1½ | 1⅛ | 2⅝ | 2½ | 1¾ | ½ | ½ | 4 |

American Machinist, N.Y.

FIG. 1. DIE HOLDER SIZES



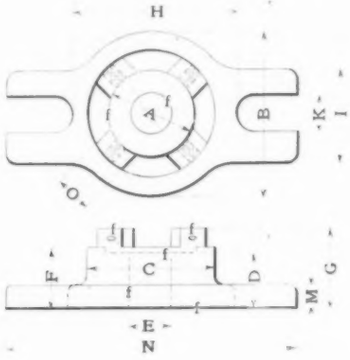

| A | B | C | D | E | F | G | H | H′ | I | J | K | L | M | N | O | P | R | S | T | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2⅜ | 2¼ | 4⅝ | 13/16 | 3 7/16 | ½ | 2 1/16 | 1 11/16 | 2⅝ | 6¾ | 7¼ | 12 | 1⅛ | 4¼ | ⅞ | 2¼ | 1⅝ | 15/16 | 11/16 | ⅜ |
| 2½ | 2¼ | 2⅝ | 4⅝ | 13/16 | 3 7/16 | ½ | 2¼ | 1⅞ | 3 | 6¾ | 7¼ | 12 | 1⅛ | 4¼ | ⅞ | 2¼ | 2 | 15/16 | 11/16 | ⅜ |
| 2⅞ | 3⅛ | 3 | 6 | ⅞ | 4⅞ | ¾ | 3 | 2 | 3⅜ | 8 | 8¼ | 13 | 1¼ | 4½ | 1 | 2½ | 2⅛ | 1 | 11/16 | ½ |
| 3¼ | 3⅝ | 3½ | 6 | ⅞ | 4⅞ | ¾ | 3¼ | 2½ | 3⅞ | 8 | 8¼ | 13 | 1¼ | 4½ | 1 | 2½ | 2⅝ | 1 | 11/16 | ½ |
| 3¾ | 4 1/16 | 3 15/16 | 6 | ⅞ | 4⅞ | ¾ | 4 | 3 | 4¼ | 8 | 8¼ | 13 | 1¼ | 4½ | 1 | 2½ | 3⅛ | 1 | 11/16 | ½ |
| 4¼ | 4⅝ | 4½ | 8 | 1 | 6⅞ | ⅞ | 4 | 2 | 5⅜ | 11 | 12 | 16 | 1¼ | 4½ | 1¼ | 3⅛ | 2 | 1⅛ | ⅞ | ½ |
| 4¾ | 5⅛ | 5 | 8 | 1 | 6⅞ | ⅞ | 4½ | 2⅝ | 5½ | 11 | 12 | 16 | 1¼ | 4½ | 1¼ | 3⅛ | 2¼ | 1⅛ | ⅞ | ½ |
| 5 1/16 | 5 9/16 | 5 7/16 | 8 | 1 | 6⅞ | ⅞ | 5 | 3⅛ | 5⅞ | 11 | 12 | 16 | 1¼ | 4½ | 1¼ | 3⅛ | 3½ | 1⅛ | ⅞ | ½ |
| 5½ | 6 | 5⅞ | 8 | 1 | 6⅞ | ⅞ | 5 | 3⅝ | 6 | 11 | 12 | 16 | 1¼ | 4½ | 1¼ | 3⅛ | 3¾ | 1⅛ | ⅞ | ½ |

American Machinist, N.Y.

FIG. 2. DIE BLOCK SIZES

the same dimensions as this one except for the bore, is used, and the redrawing is done with a "floating" die 1/32 inch smaller in diameter than the bore of the ring, and 1/64 inch lower than the ring. The reason for having the redrawing die a floating die is that, should there be any discrepancy between the centers of the two dies, the drawing punch will locate the lower die so that it will have to come right anyway.

At *e* is shown the die ring or retaining ring of tool steel, the taper at the inside being 15 degrees on a side to suit the taper on the dies. The thread on these rings and in the die beds in all cases is 10 per inch, and four holes are drilled, as shown,




| A | B | C | D | E | F | G | H | I | K | M | N | O | Screw |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 1/8 | 6 1/8 | 4 7/16 | 1 7/8 | 1 | 1 15/16 | 2 7/8 | 7 3/8 | 3 1/2 | 1 1/8 | 1 1/8 | 13 3/8 | 1 1/4 | 1/2" x 2" |
| 3 3/8 | 7 | 6 | 1 7/8 | 1 1/2 | 1 15/16 | 2 7/8 | 8 1/2 | 3 1/2 | 1 1/8 | 1 1/8 | 13 1/2 | 2 1/8 | 1/2" x 2 1/4" |
| 4 1/4 | 7 | 7 | 2 5/16 | 1 7/8 | 2 1/8 | 3 1/8 | 7 3/4 | 3 1/2 | 1 1/8 | 1 1/8 | 13 3/4 | 3 | 1/2" x 2 1/4" |
| 5 1/8 | 7 7/8 | 7 7/8 | 1 3/4 | 3 | 2 1/4 | 3 1/8 | 8 1/4 | 4 | 1 1/4 | 1 1/8 | 14 | 3 | 5/8" x 3" |
| 6 1/4 | 9 | 9 | 2 | 3 5/8 | 2 1/4 | 3 1/2 | 9 | 5 | 1 3/8 | 1 1/8 | 14 | 3 | 5/8" x 3" |
| 7 1/4 | 10 1/4 | 10 1/4 | 2 1/8 | 4 7/8 | 2 1/4 | 4 | 9 3/8 | 5 | 1 3/8 | 1 1/4 | 16 3/4 | 2 3/4 | 5/8" x 3" |
| 8 7/16 | 11 5/8 | 11 5/8 | 2 3/16 | 5 7/8 | 2 1/4 | 4 | 11 1/2 | 5 1/4 | 1 1/2 | 1 1/4 | 17 | 2 3/4 | 11/16" x 3" |
| 9 1/4 | 11 3/4 | 11 3/4 | 2 3/16 | 6 | 2 1/4 | 4 | 11 1/2 | 5 1/4 | 1 1/2 | 1 1/4 | 17 1/2 | 2 3/4 | 11/16" x 3" |

American Machinist, N.Y.

FIG. 3. DIE BLOCK SIZES

to allow tightening. The dies when new project from 1/8 to 3/16 inch above the bed and retaining ring to allow them to be ground.

It will be seen that many sizes of shells can be blanked or drawn in the same bed without removing the bed from the press, as all rings and dies are made to a standard gage.

Fig. 3 is a poppet bed of cast iron; the taper of the dies used is 5 degrees on a side, and they are held in place by four tool-steel set screws with the ends reduced and hardened. Such beds are used mostly for the redrawing of shells and not for blanking.

Bridgeport, Conn. MILLS WRIGHT.

## Computing Change Gear Ratios When the Required Lead is Odd, or Expressed in Decimal Terms

The ordinary method of converging fractions, used to change a decimal into a ratio between two whole numbers is not satisfactory, because it is difficult to remember and does not supply a sufficient number of approximate ratios from which a choice may be made that will not require special change gears.

It is probably best to compute the ratio between the required lead and unity, expressing this ratio as a fraction, and then multiplying the numerator by the number of turns per inch of lead screw. The numerator is the driver.

Required a screw with a lead of 0.7854 inch. Select two fractions, of small terms, one above, one below the value sought. In this case we will use 3/4 and 4/5. Add similar terms of these two fractions, $\frac{3+4}{4+5}$ which gives 7/9, equal to 0.778, which is too small. Adding the terms of the larger fraction, $\frac{7+4}{9+5}$, giving 11/14, which equals 0.7857. This is well within almost any desired limit of accuracy. Assuming lead screw is four turns per inch then

$$\frac{11 \times 4}{14} = \frac{44}{14}$$

is the ratio of the change gears, a result possible with any set of gears.

Let us take a metric lead, for example 3 millimeters which equals 0.11811 inch. In this example we will select 1/10 and 1/8 for our first fractions.

As before shown,

$$\frac{1+1}{10+8} = \frac{2}{18}$$

which equals 1/9 or 0.111. This is too small, so we add any numbers which will give the desired ratio between the numerator and denominator to nearest equal the desired decimal of 0.11811.

Continuing,

$$\frac{1+1}{9+8} = \frac{2}{17} = 0.1176$$

$$\frac{2+1}{17+8} = \frac{3}{25} = 0.12$$

This is too large, so we add a smaller fraction, 1/10,

$$\frac{3+1}{25+10} = \frac{4}{35} = 0.115$$

$$\frac{4+1}{35+8} = \frac{5}{43} = 0.116$$

$$\frac{5+1}{43+8} = \frac{6}{51} = 0.1176$$

$$\frac{6+1}{51+8} = \frac{7}{59} = 0.11866$$

Here we have gone too far and add a smaller fraction, as 2/17, and the third trial gives us the result as nearly as desired.

$$\frac{7+2}{59+17} = \frac{9}{76} = 0.1184$$

$$\frac{9+2}{76+17} = \frac{11}{93} = 0.11826$$

$$\frac{11+2}{93+17} = \frac{13}{110} = 0.11818$$

which we will accept, as it is very nearly correct, and any standard set of change gears will give this ratio. Assuming a lead screw of four turns per inch, the ratio becomes 52/110. If the lathe has no gear with 110 teeth, we can compound as follows: 52 teeth on spindle, into 60 teeth on steel, 24 teeth on stud into 44 on screw.

J. W. MCCONNELL.

Washington, D. C.

## Knife Edge Straight Edge Made from Old Razor

Some years ago I made a knife-edge straight-edge from a razor about 20 years old, and find it to be a very good tool.

The steel is very hard, well seasoned and tough. It does not "nick" and "warp" as unseasoned straight-edges do.

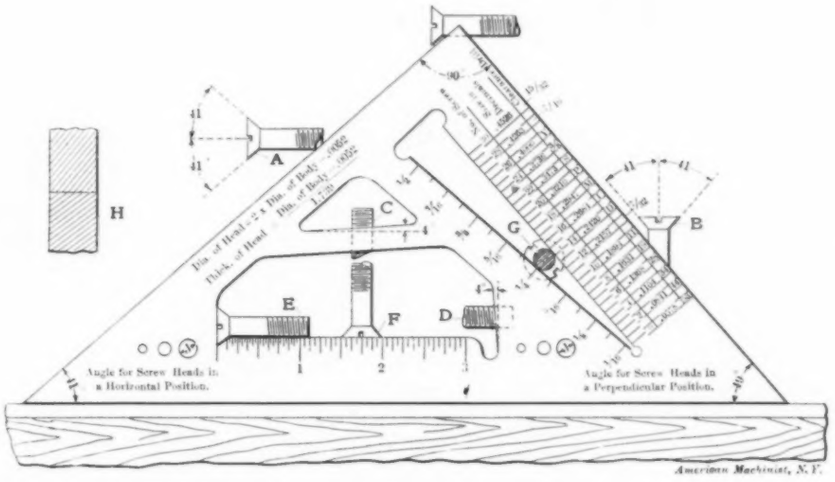
It is conveniently held by the handle when in use and distortion, due to the heat of the hand, is prevented. Moreover

the handle effectively protects the edge from injury.

Brooklyn, N. Y. F. J. B.

## Triangle for Laying Out Flat Head Screws

To simplify work, save time, and incorporate in one instrument all the required information, angles, etc., pertaining to flat-head machine and wood screws, bolts, etc., was my object in designing the triangle shown in the sketch. I have an 8-inch angle, made of steel, that cost me considerable, but I wouldn't give it up for $25 if it were impossible to get another. More time is lost, when laying out, in looking up data for flat-head screws than is necessary. To lay out a flat-head screw on an assembled jig, fixture or machine, one is compelled to guess at the size that will fit into the space best, picking up the data cards or books, and setting the dividers to size on a scale, only to find then that the screw is either too large or too small; but with this instrument a draftsman or toolmaker can lay the triangle over the work and determine at a glance the diameter and length and whether the countersink will cut out on the sides, or not, before any work has been done. It also has the advantage of permitting one to measure screws in the hand that are carried in stock and which the draftsman wishes to use on the job, without picking up calipers, micrometers, or scale to see if they will answer the purpose.




TRIANGLE FOR LAYING OUT FLAT-HEAD SCREWS

The application of the device for drawing the proper angles of screw heads and countersinks is shown at *A* and *B*, and for drawing in the threads at *C* and *D*, using the 4-degree angle, which is approximately correct for any diameter with corresponding pitch. For measuring the pitch of threads, length of heads and total length of screw, the screw is placed as at *E*. For measuring the diameter of the body the screw is slipped into the taper slot, as shown at *G* (or the instrument is placed over the drawing), to get the fractional size 1/16 to ½ inch, or the numerical size, 0 to 30, with its decimal equivalent and the nearest larger body drill size. Section lining at two different angles in separate pieces is represented at *H*.

At *J J* provision is made for different-spaced section lining, with pencil. The triangle can be made of sheet metal or celluloid, with countersunk letters, or of white celluloid, or wood, with printed graduations, letters and figures. All "cut outs" on this instrument have useful applications and aid in saving time.

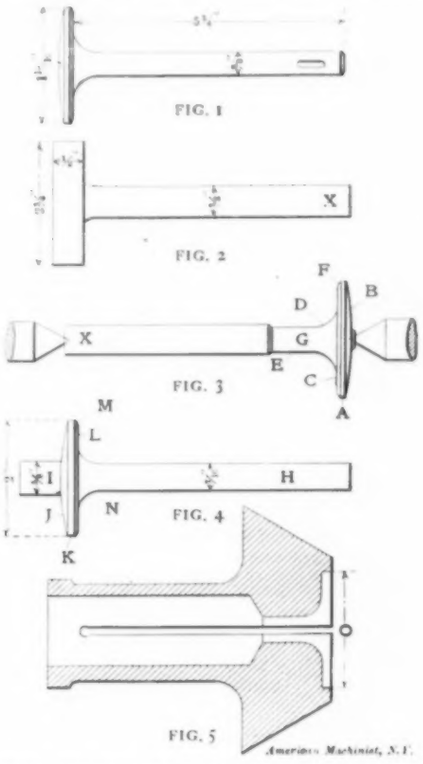
Chicago, Ill. WILLIS G. YOUNG.

## How Drop Forgings and Turret Lathes Reduce Costs

Figs. 1 to 4 show a petrol motor induction valve, for a 20-horsepower automobile engine. It is of a common type, and well known to most readers of the AMERICAN MACHINIST; yet its evolution of manufacture is interesting. They are now made in large quantities and the drop stamp has played a very important part in their manufacture; in fact, in no other branch of the engineering trade has the drop stamp figured so conspicuously as in the rapid growth of the now firmly established automobile industry.

Referring to the illustrations; Fig. 1 shows the finished valve, machined all over, and made out of 3 per cent. nickel steel. In the earlier days of the automobile industry we used to buy these valves from a firm of steel manufacturers, forged as shown at Fig. 2, by hand, at a price of approximately 60 cents each, delivered at our works. After being inspected for soundness the forgings were passed on to an engine lathe, and centered, a carrier was secured on the small end *X*, in Fig. 3, and the top *A* was turned to the drawing dimensions by the ordinary slide rest. The end *B* was next operated on, then the metal removed on the inside of the head *C*, and the radius *D* and the shank *E* were turned to about 0.005 inch over size, for a distance of about 1 inch up, exactly as shown. The bevel seating *F* was then put on; this completed the first operation.

The forgings were next turned round in the centers, and a carrier secured on the stem at the point marked *G*, just inside the radius, and the shank finished to within 0.005 inch of finished size in the ordinary way. The seat *F* and shank were finished by grinding. By this method it took a skilled man well over two hours to turn one, the labor cost alone ran well up to another 60 cents; a pretty tall figure for this job. This went on for some time until a specialist came round to see us one day and offered us the finished product, delivered at a figure just under 60 cents each for quantities; guaranteed 3 per cent. nickel, and to pass our rigorous inspection. We did not feel inclined to believe him at first, but after looking at his samples we gave him a trial order, and were quite satisfied with the result. In the meantime we investigated the matter and found out that a screw had been loose somewhere, and started to remedy matters. When the job came round again we found we could get them drop forged much nearer the finished size at about 18 to 20 cents each, as shown at Fig. 4, and placed a large order. We took the stamp-




MACHINING OPERATIONS ON AN AUTOMOBILE ENGINE VALVE

ings to a hollow-spindle capstan lathe, and gripped the shank *H* in the collet chuck, and ran a hollow box mill up the spigot end *I*, which is about 1 inch long. This operation does not take many seconds. We then turned the part *J* with the cross slide, and also the top *K*, to diameter. That finished the first operation. We next gripped the spigot *I* in the collet chuck again, and beveled the outside end of the shank with an ending-up box tool, and then roughed the shank with a box turning tool, afterward finishing within 0.005 inch of finished size with a similar tool. We next brought a steady bush into position onto *H* and finished the inside of the head *L* and radius *N*, with the cut-off slide, there being very little metal to remove on these drop forgings. At the same time *L* was faced we put on a very small bevel *M* for the seating; the spindle was then ended off to length and centered with a Slocomb drill in the capstan, of profit remains, due to improved methods of manufacture, and using drop stampings and capstan lathes.

London, England. R. CROYSDALE.

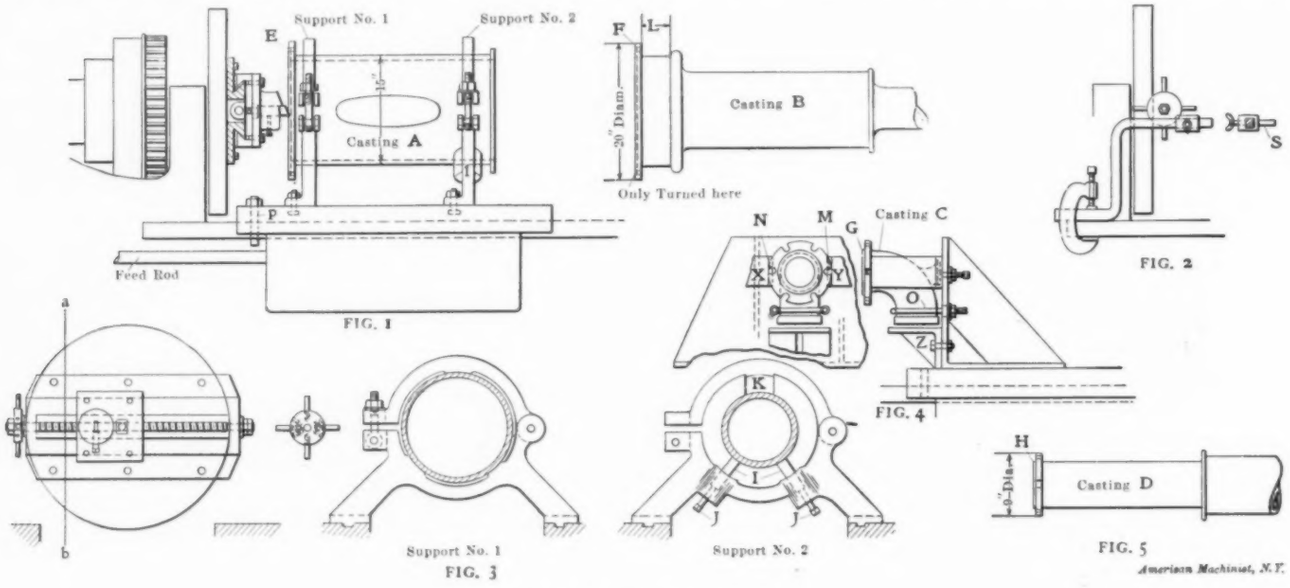
## Facing Castings in the Lathe

The sketches show four different castings which required facing on the ends, and also show the method of doing the work. The castings *A* and *B* are respectively sub-base and base of an electric-light pole, the ends *E* and *F* being bolted together. The castings *C* and *D* are for a special hydrant.

Fig. 1 shows the lathe rigged up for facing casting *A*, the only change required to face casting *B* being to insert the pins *I* in support No. 2 and use block *K*. Fig. 2 shows the arrangement of the feed-from the lathe carriage and a support similar to No. 2 substituted, with new pins *I*, both supports being used. The set screws were found to be an unnecessary refinement.

For facing casting *C* the large angle plate, Fig. 4, is placed on the lathe carriage in the position shown. The method of holding the casting will be clearly understood by referring to Fig. 4, noting that the two small angle plates *X* and *Y* have projections which fit into the casting at *N* and *M*. The only office of the plate *Z* is to support the casting until the U-bolt *O* is tightened which pulls the casting clear off the plate. The carriage is held in position by hook bolts *P*, Fig. 1, at the front and rear of the lathe. The depth of cut or longitudinal feed is obtained by turning the gear on the feed rod by hand.

It is worth noting that castings *A* and *B* had their ends cast in ring cores which




FACING CASTINGS IN THE LATHE

as also was the spigot *I*, before it was removed from the first operation.

The valves were now taken to the grinding department, and ground in the centers, to size on the stem *H* and also on the seating *M*. They were next brought back to the capstan lathe, and the head *K*, in Fig. 4, gripped in a spring collet, bored out to be a good fit, as shown in Fig. 5, the stem being about 0.002 inch slack, in the small bore. This keeps the valve very rigid and prevents any possibility of springing it while the spigot *I* is being parted off with the cross slide. This completes the valve, as far as turning goes.

By the methods here described we can now finish a valve complete at less cost than we could formerly by hand forging. This is indeed a typical drop-stamping job and the selling price of the finished product is considerably less than half we originally charged, and still a good margin

screw strike on the front side of the lathe, a similar one being used on the far side. *S* may be moved so as to reverse the feed or set out of mesh. Fig. 3 shows a plan of the tool-feed fixture. Fig. 1 is a sectional elevation on the line *a b*. The star wheel as shown in Fig. 3 is drilled and tapped so that the pins may be placed in different positions, so as to give ¼, 1/6 or ⅓ of a revolution of the feed screw at each strike. It will be noticed that the feed screw (eight threads per inch) is always in tension whether feeding in or out; also that the nut holding the star wheel in place has a small pin through it to keep it from unscrewing when a crank handle is used on the nut to operate the screw. Referring again to Fig. 1 it should be stated that the reason for not having both supports similar, that is like No. 2, is that the space *L* on casting *B* is less than *l* on support No. 2.

For facing *D*, support No. 1 is removed

also left the core for the bolt holes. This left the ends clean and without fins; the ends were pickled and brushed. Before the end core was used two and three cuts were required, while by this means only one was required. The cut was about ⅛ inch deep.

Castings *C* and *D* presented another problem, that is the preventing of the bolts which held them, from turning out of place when tightened. This was finally overcome by making a band in halves, the diameter of the flanges and wide enough to cover both flanges and also the heads of the bolts which were square. After using this rig I found a lot of ways in which it could be improved, such as using a large set screw in the upper half of the support ring, and I would have liked to do away with the hook bolts *P* which are barbarous but effective.

HERMAN JONSON.

New York City.

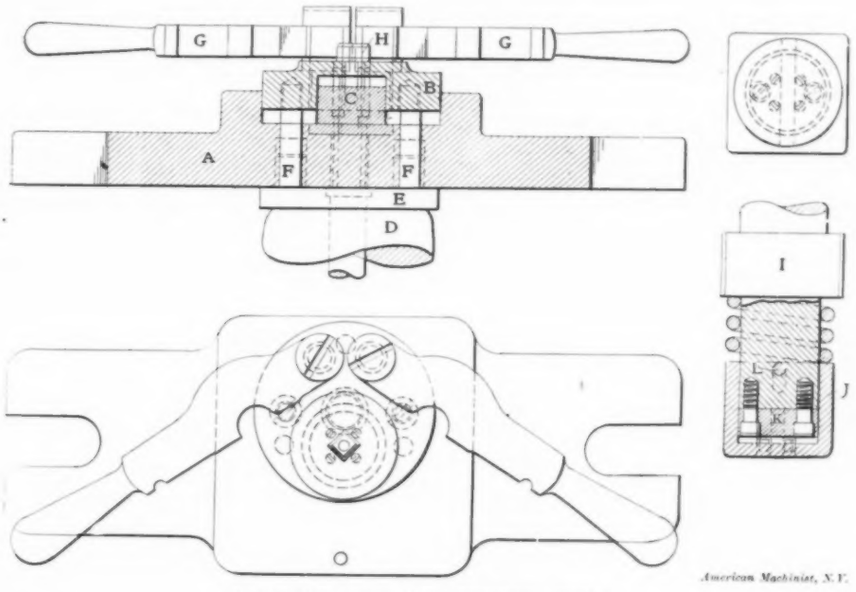
# Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

## WE PAY FOR THESE ALSO

### Riveting Device for Typewriter Ribbon Spools

On page 937, Part 1 of Vol. 32, appear sketches of tools for riveting typewriter spools, by George Lake. The sketches herewith are to show another method of doing the same job, with this difference; with the tools shown by George Lake, four blows of the press are required, while with the ones shown here, one blow only is needed. With the tools shown here a rivet is properly formed, that is, the teats, which protude through the blanks that form the sides of the spool, are thickened up to fill the hole and the surplus metal is headed over, much the same as it would be if riveted by hand. In the tools shown by George Lake, the teats are first deflected, and then clinched, thus requiring two separate blows on each side of the spool.




TOOL FOR RIVETING TYPEWRITER TOOLS

The lower portion *A* of the tool is a bolster of gray iron, machined top and bottom. It is recessed on top for the part *B*, which is of machinery steel, finished all over. It is also recessed for *C*, which is a force fit. On the lower side of *A* is shown the upper portion of rubber buffer *D*, and also a disk of machine steel *E*, which transmits the pressure of *D* to *B* by means of the pins *F F*. These are of drill rod cut to exactly similar lengths. *A* is also drilled and counterbored for two fillister-head screws, which hold *B* in position. *C* is drilled to take the four small punches, which are a force fit, and are disposed in the same positions as the teats on the spool. *B* is drilled and tapped for two screws, about which the levers *G G* are pivoted, central with the four holes through which the small punches work. *B* is also drilled for the locating peg *H*.

In the punch part to the right, *I* is the punch holder; *J* the presser; *K* the internal punch holder. In this part *K* is held to *I* by two fillister-head screws, and is also drilled for the four punches, which are a force fit. *J* is a sliding fit on *I*, and is provided with four holes, through which the punches work, and also a slot hole on the opposite sides for the peg *L*, which keeps *J* from being pushed off *I* by the spring, and also serves to keep it in proper relation with the punches.

In operating this riveter, the spools, which are assembled by hand, are placed on the locating peg *H*, and the levers *G G* are closed on the spool. The peg, shown at the front of the bolster, helps to locate the levers and prevents the operator straining the work to one side or the other; so that the alinement of the spool is preserved, and the punch part, descending, does its work in the proper place.

To set the tools in the press the peg *L* may be removed and also the part *J*, together with the spring, thus allowing the toolsetter to see when the punches in the upper part, shown to the right, match the punch holes in *B* of the lower part. It will be seen that the action of the tools is to force the side plates onto the edge of the spool barrel with the teats protruding on both sides, top and bottom, then, as the ram of the press descends still farther, the eight small punches form a rivet of that part of each teat which protruded through the side plates.

Birmingham, Eng. G. WULFRUNA.

### How I File My American Machinists

From time to time articles appear in your columns written by mechanics describing the various ways in which they file or preserve their AMERICAN MACHINISTS. I therefore feel that my experiences in this direction may be of interest to some of your readers.

The methods of filing them which I now have in use did not occur to me until after I had tried to follow the various methods suggested by others. It then seemed to evolve as the only satisfactory solution of the problem. I started to subscribe to the AMERICAN MACHINIST in 1899. At that time the journal was very little known in this country. The first copy came into my hands from an American workman who, with others, had been "imported" to show us how to "do it."

Many of my English colleagues flouted the idea of learning from the American workmen, and avoided them, but I thought that if there was nothing to be gained at least there was nothing to be lost by getting on intimate terms with them. I soon found that the origin of their many "shop kinks" and new ideas was the AMERICAN MACHINIST, which they all seemed to study so earnestly every week.

I had very little spare cash then, but determined that I would send a year's subscription to the "other side" and get an AMERICAN MACHINIST to study every week all to myself.

I had always kept myself well supplied with the best papers here bearing on mechanical matters, but there were none that seemed to supply the information which I was in need of. All the matter in them seemed to be the kind which would be useful to me if ever I held a superior position, but nothing to bridge the enormous gulf between my position then and that, what seemed to me, a far off dream.

*The* AMERICAN MACHINIST *did supply*

*the necessary bridge;* it provided me with food for thought, and I did not miss an opportunity of applying to my everyday work the lessons studied and learned, with the result that *in three years after taking the* AMERICAN MACHINIST *my wages were more than doubled.*

Of course, I did not destroy the papers when read, or lend them, or give them away, but kept them. At the end of the second year they had got to be rather bulky, and I had to cast about for some means of dealing with them.

About that time the paper had become better known here, and having an offer made to me by a foreman in the factory in which I was working for my two volumes, I sold them to him at a profit. I have often regretted it since. Then for another year they accumulated till the article at page 1407, Volume 25, interested me, and I bound that volume after the manner there described. This certainly kept them together in a compact mass.

The next year a better method was presented at page 1300, Volume 26. This I followed, making the tackle as described, and a very presentable volume was the result.

At about that time I found that I often had occasion to require matter taken from these books for use in the shop. The bound volumes were too bulky and heavy to carry about, thus rendering it necessary for me to copy out whatever matter I required, which often meant double labor; so for that reason I did not bind any more that way, but after stripping off the advertisements I punched two holes in each copy near the back and bolted the copies together with light bolts made from bicycle-spoke wire. By this means with very little trouble I could get out a single copy or article at will. But the time consumed was too great to warrant this method a success. I found that it caused more inconvenience and wasted more time to get out an article needed than to deal with the whole volume intact. I had by this time become tired of trying to improve matters and decided to make the best of other people's methods of keeping literature and get them bound. So I went to a bookbinder and got him to bind up all that I had been experimenting with into half-year volumes. But I was still unsatisfied owing to the un-get-at-able-ness of single articles when the numbers are bound together, so I had another think and devised the scheme to be described, which is very simple and cheap, while it has the desired advantages over the bound volume. I went to a provision store and found among their heap of empty packing boxes one which suited my purpose. This was 18½ inches long, 12½ inches wide and 9½ inches deep. The inside I divided into six compartments with thin boarding, each compartment being sufficiently wide to take 26 numbers, with the advertisements removed. I fitted some hinges to the cover and gave the box a coat of paint. It was then ready to receive three years. Every six months, as soon as the half-yearly index arrives, I strip the advertisements off the numbers and place that portion containing the reading matter back downward in a compartment in the box, the index being put in its relative place at the left. Whenever I am in need of information I first take an index and look up in it the headings bearing on the subject matter sought. Then from the volume I extract the likely article or articles, glance through them to see if any of them meet my requirements, returning to their respective places those which do not, and retaining those I wish to make use of. In place of these, slips of paper are left denoting the matter taken and other necessary particulars. At first I found some trouble in returning the loose leaves to their former positions, but found that with a piece of cardboard between the leaves to make them stiff they can be pressed into position and the cardboard withdrawn, leaving the paper in place, the friction between the leaves of the paper being greater than that between the paper and cardboard.

I have found this plan to be devoid of all objectionable features, and to have many advantages over any I have tried or read of.

G. H. GIBBS.

Loughborough, England.

## A Tool for Wood or Fiber

On page 20 of the July 1 issue Dixie tells us about a turning tool for wood and fiber.

I would like to ask Dixie if he has used a tool like that on actual turning and what results were attained? I should think that a tool made in that manner would have a tendency to pack full of chips and choke, particularly when turning wet maple logs or small rolls of dry poplar.

If Dixie has successfully turned fiber with a steel tool made in this or any other shape and secured a good finish and a uniform size to the parts turned, I think a more detailed description would be of interest.

I recently had a number of small fiber disks 7/8 inch in diameter to face up to 0.3 inch thick, where the finish had to be good and the size right within a couple of thousandths. There was perhaps ten or twelve thousandths to be removed from each side.

The job was done on the bench lathe, but I was unable to get a steel tool to do more than two without regrinding, although I tried Novo and others.

The pieces were finally finished by soldering a flake of crude carborundum onto the end of a strip of brass in such a way that the brass supported the cutting edge which was formed by the carborundum flake. When once set this tool would hold very close to size and only required lapping once in doing the whole lot of over a hundred pieces. The polish was obtained afterward by applying fine emery cloth and oil lightly to the surface.

L. L. ARNOLD.

East Greenwich, R. I.

## Cutting Internal Gears with a Slotting Attachment

In answer to Mr. Groocock's reference to the attachment for cutting internal gears on the slotter, which I described on page 445, he is quite correct when he says the stop, or depth gage for limiting the depth of the cut, should be placed central (as in one case), and should be very stiff. Stiffness is most important, for unless the stop is of sufficiently large diameter it will spring when the table is fed up against it with the result that the gear teeth will not be of the same depth all the way around. As Mr. Groocock remarks, this applies particularly when semi-skilled labor is used. I can assure him we use only semi-skilled labor on this particular job, and it is a fact that we obtain far better product than we ever did when we had these gears cut out by various well known firms of gear cutters.

Mr. Groocock says, on page 940, "the tool shown is rather a poor one for slotting, and I should anticipate that in slotting a 12-pitch wheel in steel it would move, unless the sides of the cutter were serrated, etc., and it would be interesting to know if any trouble was met through this cause, and if so, how it was remedied." The device was designed for cutting gears from 12 to 20 pitch, chiefly in brass and malleable iron, and to the best of my recollection we have never cut any 12 pitch in steel. The cutters are ordinary internal cutters made by Brown & Sharpe, and have not serrated sides, but are ground quite plain. We consider they are as near perfection as possible, and leave nothing to be desired in any way.

We have certainly never been troubled by their slipping around on the center clamping bolt. This is, no doubt, due to the comparatively large area of the cutter face in contact with the slotted bar, as only a little over the depth of tooth on the cutter protrudes outside the bar. If through carelessness on the part of the operator a very deep cut were taken, the cutter might possibly slip around, but upon inquiry, I find there is no case on record of it having done so yet; but even if it did, it would only act as a safety valve, and probably do no damage.

In reference to Mr. Groocock's remarks regarding the shape of the cutter, he is quite right; it is turned the same profile as an ordinary internal gear cutter, of course.

England. C. CLOBURN.

# AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.



*CIRCULATION STATEMENT*

*During* 1908 *we printed and circulated* 1,205,750 *copies of the* AMERICAN MACHINIST.

*Our circulation for July,* 1909, *was (weekly, monthly and European)* 110,000.

| | |
|---|---|
| *August* 5 | 35,750 |
| *August* 12 | 19,750 |
| *August* 19 | 19,000 |
| *August* 26 | 19,000 |

*This paper reaches* 35,750 *separate readers each month and* 19,000 *each week.*

*None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.*


## Contents


| | PAGE |
|---|---|
| A Metal Dynamograph and Results | 349 |
| Some Typewriter Shop Tools | 353 |
| Proportions of Ball Thrust Washers | 355 |
| The nonmagnetic Ship "Carnegie" | 356 |
| Volumes, Pressures and Temperatures in the Adiabatic Compression of Air | 360 |
| Local Hardening | 361 |
| Turbine vs. Combined Reciprocating and Turbine Steam Sets | 361 |
| Flywheel Testing Pit at Purdue University | 362 |
| Notes on the Design of an Engine Lathe | 363 |
| The Ideal Piston Pin | 366 |
| A Homemade Valve | 367 |
| Echoes from the Oil Country | 367 |
| Some Features of the Premier Shop | 369 |
| An English Belt Drive | 370 |
| Practical Letters from Our Readers: Model vs. Sketch....Press Tool Standards....Computing Change Gear Ratios....Triangle for Laying Out Flat Head Screws....How Drop Forgings and Turret Lathes Reduce Costs....Facing Castings in the Lathe | 371-374 |
| Discussion of the Previous Question: Riveting Device for Typewriter Ribbon Spools....Filing AMERICAN MACHINISTS....A Tool for Wood or Fiber....Cutting Internal Gears | 375-376 |
| Unnecessary Accuracy | 377 |
| Progress of Savings Bank Life Insurance in Massachusetts | 377 |
| New Tools and Machine Shop Appliances | 379 |


## Unnecessary Accuracy

There seems to be a growing feeling in many quarters that we have in too many instances overstepped the practical in our demands for accuracy in the construction of a large class of machinery. While it is true that many shops claim to work to less than a thousandth of an inch when in reality they have no means of measuring anywhere near this, there are many instances where machinery is being built with a half-thousandth limit which would be equally serviceable, and in many cases actually better, with a considerably wider limit.

There is little doubt that much of the difficulty experienced with new machines comes from their being too closely fitted and we are informed that several of the large manufacturing plants make it a point to take down nearly every machine tool purchased and in the case of rods or shafting running through solid bearings, to grind them so as to have an appreciable play between the shaft and the bearing. This is done to allow plenty of room for oil, which takes up more space than many of us realize, and in this way avoid all trouble and delay from having bearings of this kind rough up or stick.

This has been realized by one of the best lathe builders in this country who has come to the point of making a definite amount of play for oil allowance between the spindle and bearings. The spindles are not considered properly finished until a very accurate indicator shows that they can be lifted from a half to a thousandth of an inch in the bearings after the bearings are scraped to fit. We are too apt to overlook the expansion of spindles both from the heat of running and from that transmitted from the work, which in many cases is considerable.

A very practical example of over refinement in accuracy came to notice recently in the building of four-cylinder gas engines. The engineers had prescribed very careful limits and the inspectors were instructed to discard all cylinders showing a variation in diameter of 1/1000 of an inch. The mechanic in charge being satisfied that this was an entirely unnecessary requirement, picked out four of the worst cylinders which had been thrown out and had them assembled into a complete engine, carefully forgetting to mention that these cylinders had been discarded. This engine then went to the testing room with a lot of others and was passed without question, developing its full power and being pronounced satisfactory in every way. He then made up the rest of the cylinders, none of which were over five one-thousandths out, and if the testing engineer had not inquired as to what had been done with the discarded cylinders he might never have known that they were tested and passed with the rest.

In another case a certain piece of machinery had a valve seat which was subjected to about 400 degrees of heat. These valve seats were in very thin steel cages and the inspectors were instructed to discard all which varied one one-thousandth of an inch on any of the several diameters. Here again the practical mechanic did some thinking on his own hook and taking a number of these which had been thrown out as being too small, he simply held one end in his fingers while he dipped the large end in the kettle of hot soda water. Then he called the inspector who found them slightly over size. When it was demonstrated that they would vary to such an extent in the moderate heat of a soda-water tank it was decided that a much wider limit could safely be allowed in consideration of the heat to which they were subjected while in use.

In the making of master plates or any other accurate tool work there can hardly be too close a limit and no one has advocated accuracy in machine-tool construction more than the AMERICAN MACHINIST; but as in every other phase of our existence we are pretty sure to go to the extreme before we finally settle back to a reasonable mean or medium course, and there are many indications that we are now approaching this in the construction of machine tools and similar machinery.

## Progress of Savings Bank Life Insurance in Massachusetts

A little more than a year ago on page 172, Volume 31, Part 2, we reviewed the beginnings of savings-bank life insurance, or wage-earners' life insurance, in the State of Massachusetts, commended the movement and wished it success. It is now fitting to review briefly the work that has been done and the results obtained during the year that has elapsed. The progress made has been very satisfactory. Two banks have established insurance departments. These in turn have about 100 agencies, and up to July 15, have written about 2500 policies. While these policies do not represent a very large aggregate sum, yet they show a creditable start, and prove that the experimental stage has been largely passed and that the future of the system is a useful one.

One of the arguments urged against the scheme has been that individuals will not take advantage of a chance to obtain life insurance, even on the most advantageous terms, unless they are induced to do so by the soliciting of persistent agents. There is a degree of truth in this argument, but the last year has developed a large amount of gratuitous soliciting through the channels of several public-spirited organizations and by progressive employers, who were willing and ready to place the subject before their employees and give them the benefit of the cheapest and safest life insurance and

old-age insurance ever offered in the United States.

It is stated that most of the policies that have been written in Massachusetts have resulted from the interest taken by employers and that the general public, outside of the wage-earning class, has not yet begun to respond to any considerable extent, although savings-bank life insurance has attractive possibilities for nearly all classes of citizens. We are extremely gratified at this leadership taken by the employers of labor. In a short list of companies which have taken out agencies and in whose works a considerable number of policies have been written, we note the names of the following machine-building firms: Fore River Shipbuilding Company, Quincy; Tubular Rivet and Stud Company, Quincy; and United Shoe Machinery Company, Beverly.

One uniform method which has been adopted in bringing the matter to the attention of the employees is by inserting in the pay envelops leaflets describing the new policy and indicating some officer of the company who is made responsible for presenting the proposition to the men and women in the shop.

Among organizations which are active in furthering the work of education among the wage earners of the State are: The Massachusetts Saving Insurance League, which, by the way, is managed from the office of Louis D. Brandeis, the father of the savings-bank insurance plan; The Boston Merchants' Association; The Women's Educational and Industrial Union; The Trade Union Auxiliary Committee of the Massachusetts Saving Insurance League. Their work has been very successful, for, "It has been found that wherever the subject is attractively presented to the employees a large percentage of them apply for policies, this, too, in spite of the fact that a great deal of industrial insurance is already in force and that many Massachusetts wage earners are able to take out ordinary or annual payment insurance."

The Boston Merchants Association sums up in a small educational booklet the concrete advantages of this system of life insurance in seven items, which are:

"The objects of the act are most commendable and so far as it is availed of it will prove of great value, not only to the insured but to the whole community.

"It will immediately benefit the worker, employer, taxpayer and the citizen.

"It is thoroughly in line with those policies which have placed Massachusetts at the head of the list of States in guarding the welfare of her workers.

"It encourages thrift and economy and discourages waste and extravagance.

"It enables producers to forefend the event of accident or disease and to distribute a part of the fruit of their useful energy over the years of their decline without paying heavy to private corporations for the privilege of doing so.

"Its practicability is already demonstrated.

"It is entirely in accord with and a natural development of the purposes for which savings banks were established in that it encourages habits of thrift and economy and enables wage earners and other people of small means to provide for their families and for old age, illness and other unforeseen contingencies much more effectively than has heretofore been possible by the mere accumulation of savings."

We can say no stronger words of commendation for this movement than those contained in our former editorial. The successes of the last year are real and extremely gratifying; the future is promising and useful. The next step to be desired is action by some other State following in the lead so admirably set by Massachusetts. Here is a real opportunity for public-spirited manufacturers to lead the necessary agitation to produce legislative enactment establishing wage earners' life insurance throughout their State. The passing of such an act and the carrying out of its provisions offer immediate and direct benefit to wage earners, employers, tax payers, and citizens alike; for its end is to promote both thrift and industry and it is in hearty accord with American ideals to which old age pensions from public funds are repugnant.

## New Publications

GEAR-CUTTING MACHINERY. By Ralph E. Flanders. 315 5¼x8-inch pages; 219 illustrations; indexed as to manufacturing firms and inventors. John Wiley & Sons, New York City. Price, $3.

The scope of this work is expressed in an explanatory title thus: "Comprising a complete review of contemporary American and European practice, together with a logical classification and explanation of the principles involved." While this is surely ambitious it is lived up to in the work. In going over its pages we note no important principle of gear-tooth forming, nor any important type of machine that has been omitted. The subject matter has been published before in the columns of *Machinery* and has thus been read by a wide circle of technical readers. There are eight chapters with the following headings: "Methods of Forming the Teeth of Gears;" "Machines for Forming the Teeth of Spur Gears" (two chapters); "Machines for Cutting the Teeth of Internal Gears and Racks;" "Machines for Cutting the Teeth of Worms and Helical Gears;" "Worm-wheel Cutting Machines;" "Machines for Forming the Teeth of Bevel Gears" (two chapters). As indicated by these headings the work deals with the underlying principles involved and the general features of the mechanism. The arrangement of the subject matter is best described in the words of the author's preface, "The machines are described in the order determined—first, by the form of gear each is designed to cut; next, by the principle of action involved; next, by the method of operation employed; then by the kind of mechanism used; and finally, by the structural design of the machine." The result is undoubtedly the best work of its kind in the field of English technical literature. There are only a few minor points that we might wish to see differently treated. Mr. Flanders pertinently remarks on page 129, "It might be mentioned in connection with the name 'spiral' gearing that gears of this kind are not spiral at all, but helical," yet he has been far from consistent in using the word "helical" instead of "spiral." We regret to find several places where, by inference, at least, the design of certain foreign machines is considered as a copy of an American machine. While such copying has been done, the old adage counsels the dweller in a glass house to refrain from throwing stones, and American designers are by no means free from the habit of copying from their European brethren.

INDUCTION COILS; DESIGN AND CONSTRUCTION. By A. Frederick Collins. Published by Munn & Co., New York, 1909. Cloth; 395 pages, 6x9 inches; 135 illustrations; numerous tables. Price, $3.

Those parts of this book which are compilation are excellent; the few places where the author has indulged in original explanation or presented his own ideas of things are weak. The chapters on practical construction are highly meritorious, the one on the theory of operation is unscientific and inadequate. The tables in Chapter XX appear to have been collected rather indiscriminately, and without much consideration of their relation to each other.

Taking the book all in all, however, it should be very useful to anyone concerned with the manufacture or repair of induction coils; but the user should have sufficient fundamental knowledge of electricity and magnetism to be independent of the technical instruction which the author tries to impart.

---

Rumor has it, according to the *Scientific American*, that another long step forward has been made in the art of armor-plate manufacture. The new plate, which is fabricated from a steel alloy, combines great toughness with extreme hardness of face, and in a recent test a 6-inch plate stopped a 9-inch capped explosive shell. If it was done, the new armor must be even more superior to Krupp armor than Krupp armor is to that made under the old Harvey patents.

# New Tools and Machine Shop Appliances

## Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

## THE LATEST INFORMATION

### Universal Ball Bearing for Shaftings

These ball bearings have been especially designed to handle heavy loads, using the two-point bearing so as to be free from all possibility of side strain and allow an end movement of the bearing, should this be necessary. Briefly, it consists of an outer casing, so proportioned that it will fit any standard shafting hanger as shown in Fig. 1, and containing inside this a hardened and ground steel case at each end to receive the triple ball bearing shown in Fig. 3. The inner ball race is a hardened and ground sleeve with a lining of a good antifriction metal which fits over the shaft. Between the ball bearings at each end is an oil reservoir which insures thorough lubrication both to the balls and between the shaft and the soft metal lining of the inner ball in case a broken or defective ball should introduce excessive friction in the ball bearing itself.

In this way the bearing can be called a combination plain and ball bearing, as no matter what happens to the balls, the bearing still remains in as serviceable condition as any plain bearing, so that all danger of causing a shutdown through any failure of the balls is eliminated. This feature of the soft supplemental sleeve is characteristic of the Clark ball bearing.

These balls are separated by thin steel rings with a thicker ring on the end; by transposing these rings the balls can be made to take entirely different tracks so that the wear can be reduced to a minimum, and all adjustment of the ball races done away with. As can be seen in Fig. 2, the inner ball race which fits the shaft is somewhat shorter than the combined length of the balls and separating rings. This gives a definite amount of end movement through which the shaft can carry the inner sleeve before sliding in the sleeve itself.

The outer ring holds the bearing on that end in place and outside of this goes a heavy felt washer protected by a cap or guard which prevents escape of the oil along the shaft as well as the entrance of dust. These are made by the United Bearings Company, Bradford, Penn.

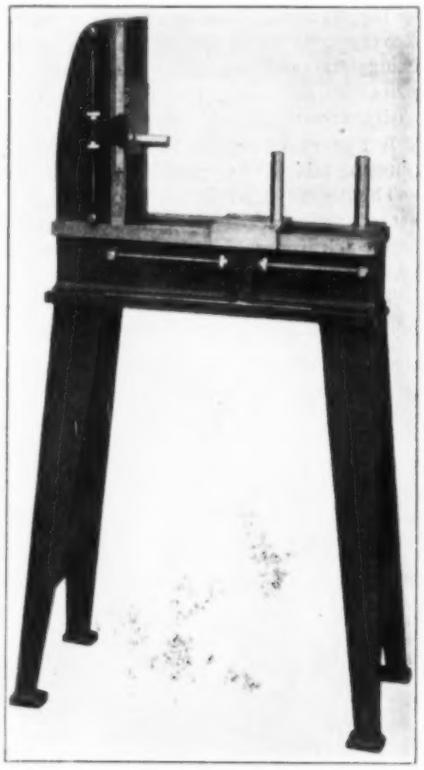
A UNIVERSAL BALL BEARING FOR SHAFTING

### Bevel and Spur Gear Testing Machine

More and more attention is being paid to securing proper running gears, and the machine shown is for testing the running of both spur and bevel gears.

The gears are mounted on removable studs, which are held in adjustable slides, moving freely by hand, in both horizontal and vertical directions, and which can be clamped at any point. A fine adjustment is provided on each slide by means of a screw and nurled nuts, together with a vernier scale reading to thousandths of an inch, so that correct center distances between studs can easily be found. The slightest imperfections in the gear teeth can readily be detected, and the cause analyzed by means of this device.

The shortest distance between center to center of studs for spur gears is 2 inches, and the greatest 19½ inches. This permits



BEVEL AND SPUR GEAR TESTING MACHINE

of the testing of a pair of gears 2-inch pitch diameter as the smallest, and a pair 14-inch pitch diameter as the largest, or a combination set of 4- and 35-inch pitch diameters. It will also take miter gears from the smallest up to 18 inches diameter, or a combination of bevel gears 4- and 32-inch pitch diameter. Each machine is furnished with two studs 1 inch in diameter by 4 inches long. The net weight is 325 pounds, and the floor space, 16x34 inches. It is made by the Cincinnati-Bickford Tool Company, Cincinnati, O.

## A 30-inch Vertical Boring Mill

The halftones, Figs. 1 and 2, show a new boring mill which has recently been put on the market by the Colburn Machine Tool Company, Franklin, Penn.

Features of merit have been incorporated in the design of this machine. The main drive, shown in Fig. 2, is mounted on a separate frame so that it is easily removable from the main housing of the machine. This construction makes it very convenient for assembling when being built and, when in use, should repairs be necessary, the parts are thus easily accessible.

A foot brake is also supplied for stopping the table in any position.

The turret head is pentagonal and is set on an angle of eight degrees, giving ample clearance for large tools when swung over the slide.

The turret slide can be swiveled to any angle up to 30 degrees in either direction, and a graduated scale and pointer permit the easy measurement of the depth of cut.

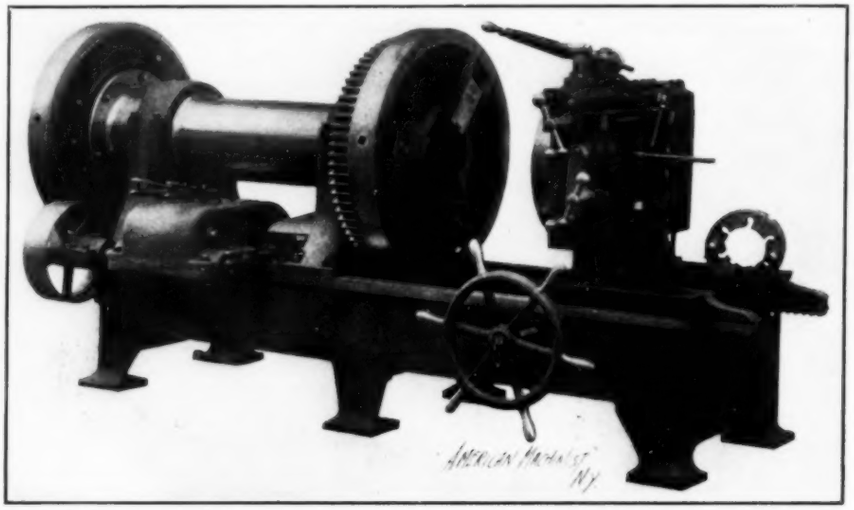
The main spindle has 16 changes of speed and there are eight vertical and horizontal feeds.

The table is either plain or equipped with three or four jaws.

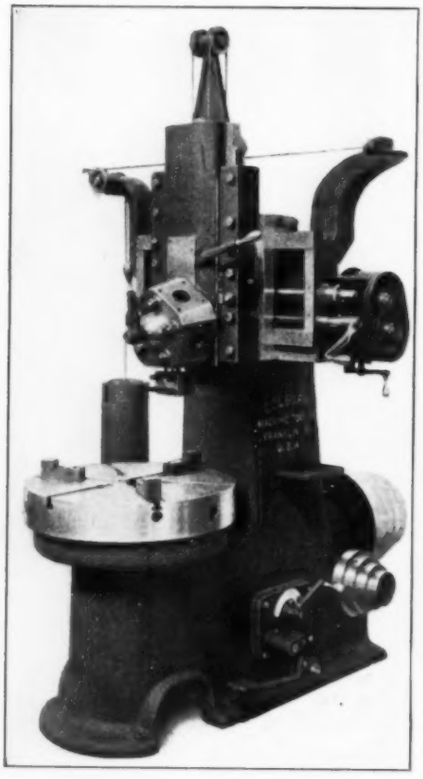
The machine is supplied with a two-speed countershaft.

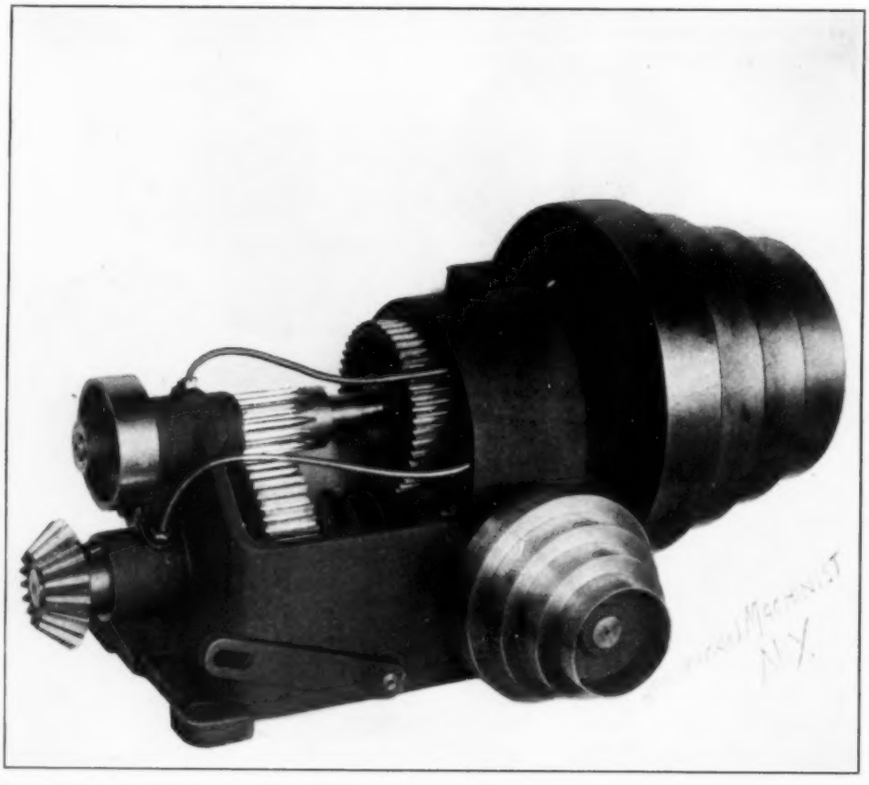
## Duplex Pipe Cutting Machine

This is known as the No. 8 Duplex pipe-cutting machine of the Bignall & Keeler Manufacturing Company, Edwardsville, Ill., and handles pipe from 2½ to 8 inches in diameter. As equipped, and without a special holder, it will thread a piece of pipe as short as 4½ inches between threads. The die head is low, so as to bring the handles and die lever within easy reach of the operator. The adjustment necessary to obtain threads of different sizes is made by turning the adjusting nut attached to the cam-ring bracket by means of a swivel yoke. The adjusting screw passes through this, and is connected to the die lever. Turning the nut in either direction revolves the cam ring, and expands or contracts the die. The dies can be readily removed and changed when necessary.



A LARGE PIPE THREADING AND CUTTING MACHINE





FIGS. 1 AND 2. 30-INCH VERTICAL BORING MILL WITH ITS MAIN DRIVE SEPARATE

The steady slides support the pipe while it is being cut off, and have interchangeable hardened-steel faces. One of these slides is attached to the cutting-off device, so that the tool is always well supported close to the work. The reaming tool is held in a tool post on the cut-off slide, so that it is always in position. Each of the chucks is independent, and has three jaws, the hardened-steel grippers being dovetailed into the jaws, so as to be easily removed for sharpening. Speeds are obtained through the gear box and a compound sliding gear on one of the shafts, there being no rocking gears or clutches.

## New Model Star Lathe

The Seneca Falls Manufacturing Company, Seneca Falls, N. Y., have redesigned both their 9- and 11-inch Star lathes, as shown in Fig. 1. They are now mounted in the oil pan shown, have spindles of 65-point carbon steel and large ring-oiling bearings. The nose of the spindle is only threaded part way, and is ground to size to insure accurate fitting of chuck and faceplates. Gears have been guarded, change gears rounded on the edge for convenience in handling, patented slip-ring washers hold the change gears in place and allow for instant removal, and all screws, nuts and other small parts liable to become bruised are case hardened.

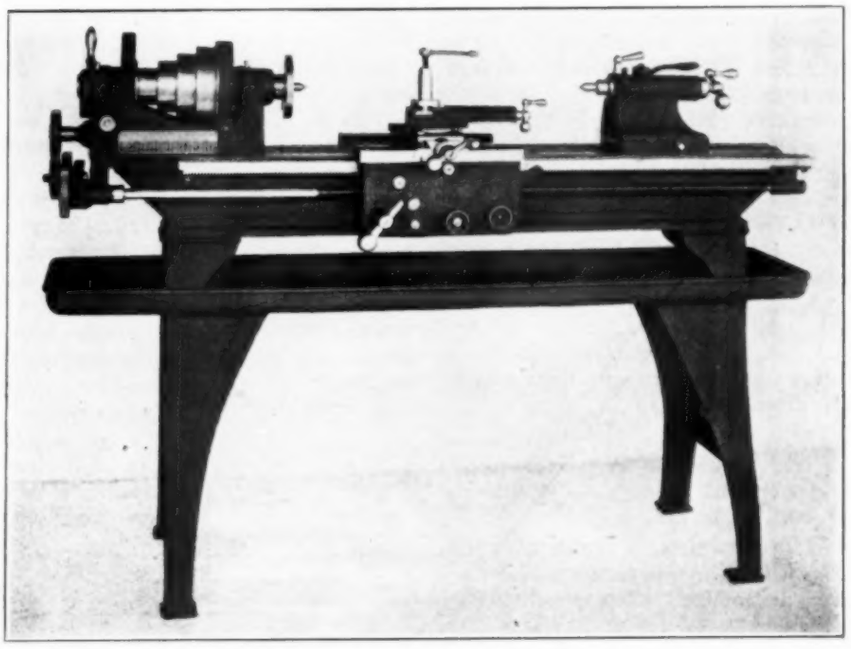


FIG. 1. STAR LATHE, 11 INCHES SWING; 5-FOOT BED

The carriage has been strengthened, is provided with T-slots and has a guard extending the full length of the cross slide to protect the screw and the ways. The cross-feed screw has a micrometer collar, graduated to thousandths, which is secured by a friction spring and can be readily set as desired. Taper attachments can be supplied, or attached at any time, as can plain or compound rests. Automatic cross and longitudinal feeds are driven by a friction clutch and a phosphor-bronze worm running on a splined lead screw. All threads from 3 to 72 per inch, including 11½ and 27, can be cut with the gears furnished, or metric threads can be cut either by using translating gears or by substituting a metric lead screw.

Fig. 2 shows a new countershaft supplied with each lathe, which has a new and efficient friction designed with an ample friction surface inside of the belt pulley. It is also supplied with a belt shifter for the upper cone, making it very desirable in shops having a high ceiling and also saves considerable time in shifting belts as well as being easier on the belt and avoiding possible injury to the workmen.

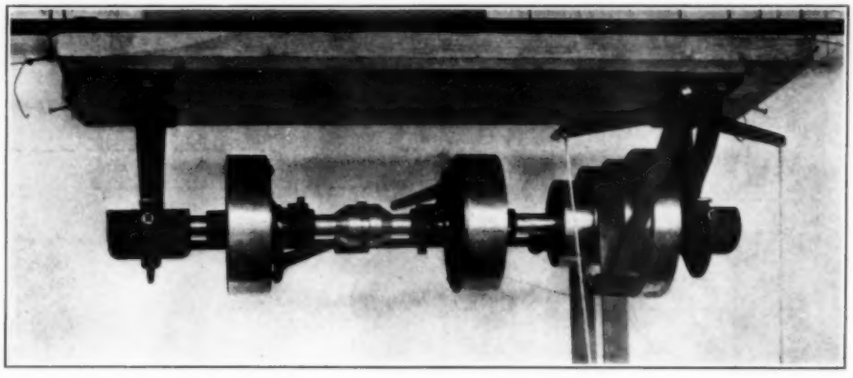
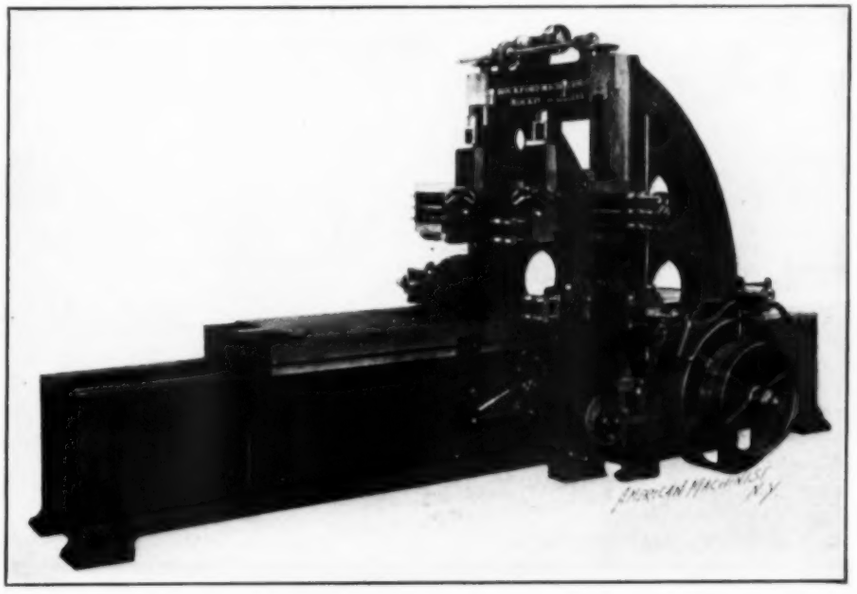


FIG. 2. FRICTION COUNTERSHAFT WITH BELT SHIFTER ON CONE

## A New Rockford Planer

The Rockford Machine Tool Company, Rockford, Ill., is increasing its line of planers, and we show herewith its 32x 32-inch with an 8-foot bed, equipped with four heads. As will be seen, this is a heavy machine for the size, being designed for heavy duty.

The driving mechanism is all inside the bed, and the bearings have long straight bushings fitted into holes bored in the bed



THE ROCKFORD 32-INCH PLANER

itself. The heads on the cross-rail have a down feed of 12 inches, while all of the heads have horizontal, vertical and angular feeds. The feed friction is of the combination releasing type, the feeds being changed by the knob shown in front, and a pointer is provided to indicate the feed obtained by the different settings. This allows the feed to be readily changed from roughing to finishing, and back to roughing again for the next piece, with a certainty of obtaining the same feed every time. All bevel gears, pinions and feed racks are made of steel and all bearing surfaces are provided with taper gibs for adjustment.

## A Safe Press

In the endeavor to produce a press which should be safe for the operator and avoid the accidents which are all too common, the Queen City Punch and Shear Company, Cincinnati, O., has designed the machine shown in the accompanying illustration. This is provided with two dies, one of which is always clear of the punch, while the other holds the work in position to be operated on. The machine is designed to run continuously, and be handled by two operators, one at the front and the other at the back.

In the position shown, the front die can be loaded by the operator without danger of accident of any kind, while the piece in the back die is being operated on. On the return stroke of the punch the cam and lever mechanism at the side brings the freshly loaded front die into position, and carries the back die with its finished piece back to the operator, who replaces it with a new blank. This obviates the necessity of the operator's hands coming under the punch at any time, and allows the press to be run continuously instead of stopping between each operation. The machine shown is 36 inches between housings, and weighs 7300 pounds, being designed for a special line of sheet-metal forming. Either operator can stop the machine instantly by the treadle, which extends in both directions under the center of the machine.

FIG. 1 FIG. 2



FIG. 3 FIG. 4

American Machinist, N.Y.

NEW TOOLS FOR THE SHOP AND TOOL ROOM

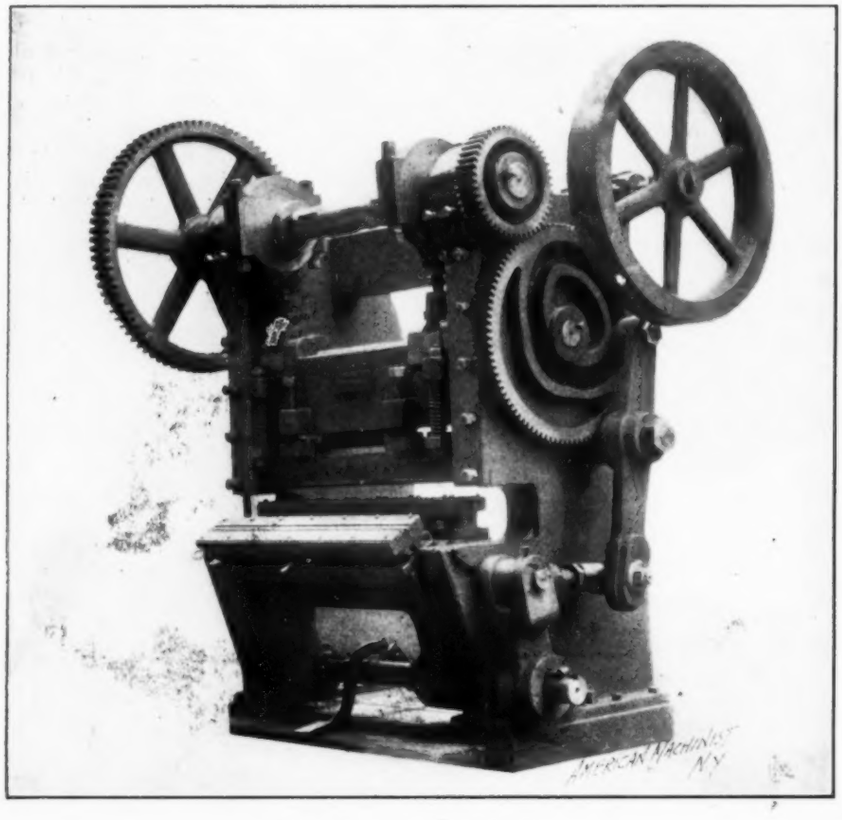
## Four New Tools for the Shop and Tool Room

The illustrations show four new tools which have recently been designed by the L. S. Starrett Company, Athol, Mass. Fig. 1 is a telescoping gage which takes the place of calipers in measuring holes, and seems to have several advantages over the ordinary caliper. One side of the measuring head telescopes into the other and is locked in position by the small nurled-head screw running through with the handle. The telescopic head is compressed to a size smaller than the hole, and locked in this position by the screw while it is being inserted. After it is in place, the screw is released so that the head expands to the diameter of the hole and is again locked by the small screw before being removed.

Fig. 2 is a gage having four tapered leaves which measure from 1/16 inch up to 1 1/16 inches, by 64ths. It is designed especially for measuring the inside of brass and steel tubes, but will be found very useful in measuring drilled holes and other uses.

Fig. 3 shows a set of four buttons for use in locating holes by the button method which is very largely used in tool-room practice. These buttons are hardened and ground to the standard size, 0.4 in diameter by ½ inch in length, and are supplied with screws and washers already for use. They are furnished fastened to a small plate as shown, which makes a very convenient holder when not in use. These will be found very convenient by any toolmaker, and should prove an easy introduction to this system of laying out work for those who have not already tried it.

Fig. 4 shows a double scratch gage, both bars being held in an octagon-shaped head, the plain bar being 4, and the other 8 inches long and graduated to thirty-seconds of an inch. By its use either one or two parallel lines can be drawn at the same time, which is very often a convenience.



A SAFE FORMING PRESS WITH TWO DIES

# The Blériot Monoplane That Flew the Channel

**Features: Single Supporting Plane, Propeller in Front, Aluminum as Material of Construction, Weight Factor 4 1-2 Pounds per Square Foot**

## SPECIAL CORRESPONDENCE

Interest, study and speculation have been suddenly centered upon the monoplane type of aëroplane, as distinguished from the biplane type, owing to the feat of M. Blériot in successfully flying across the English channel from the French to the English shore with such a machine. Heretofore, the machines that have been illustrated and described in the AMERICAN MACHINIST have been of American make and of the biplane, or double-decked, type of construction. It is, therefore, with special gratification that I am enabled to present the details of the first European machine to be described in the AMERICAN MACHINIST; details of a machine that differs radically in type from the successful machines used in America, and furthermore, the identical machine that is today known the world over because of its spectacular invasion of England through the air.

The machine has been frequently and most aptly described as "bird-like." A glance at the halftone illustration, Fig. 1 shows that this characterization is most happy. That view shows the Blériot machine as it appeared on the morning of July 25, last, soon after it left the French shore at Calais. The companion illustration, Fig. 2, shows the machine in the same flight as it approached the chalk cliffs of the English coast, near Dover. This combination of views is peculiarly happy because the one shows the machine in flight from the front and the other the machine in flight from the side.

FIG. 1. LEAVING CALAIS

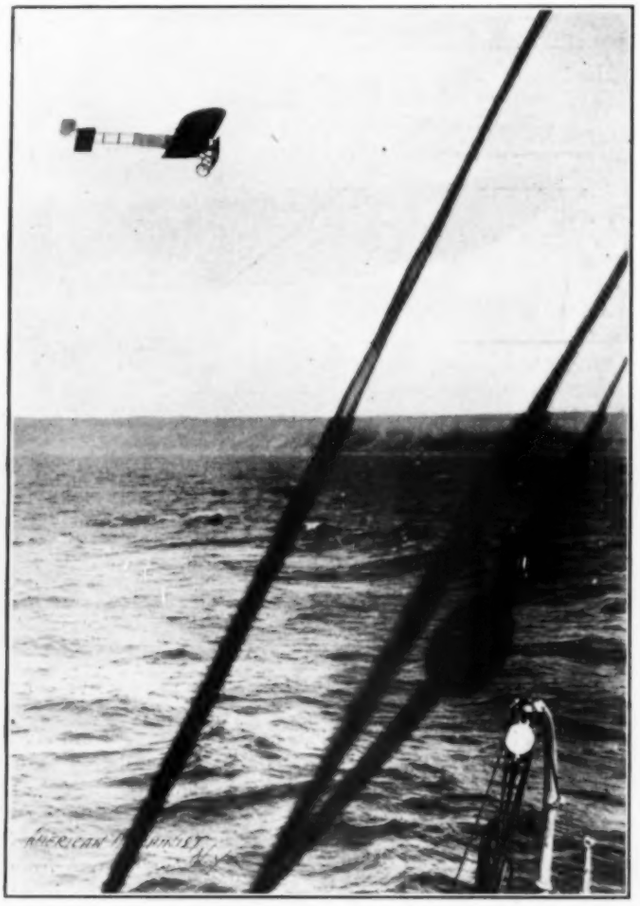


FIG. 2. APPROACHING DOVER

BLÉRIOT MONOPLANE FLYING THE CHANNEL

### DEVELOPMENT OF THE BLÉRIOT MONOPLANE

M. Blériot began to experiment with his first machine in 1896 in conjunction with M. Voisin; they experimented on Lake Enghien with an aëroplane mounted on detachable floats of rubber-covered canvas filled with air. This machine was built to compete for the Deutsch-Archdeacon prize of $10,000, offered to the first machine to fly a kilometer (3280 feet) in a closed circle. An attempt was made in November, 1906, at Bagatelle, near Neuilly, but it was unsuccessful. After having built ten machines and flying on October 31, 1908, from Toury to Artenay and back, in December, 1908, Blériot built his No. XI machine and exhibited it at the Grand Palace exhibition.

This machine made its first trial on January 18, 1909, and its first flight in February at Issy-les-Moulineaux. It was also tried at Buc in February and March with an Esnault-Pelterie motor. The surface of the wings, which was first 12 square meters (129 square feet) was increased to 15 square meters (161 square feet). With these wings the small monoplane could go up very easily, but could not stay up longer than two minutes. It was then decided to change the engine and put in an Anzani three-cylinder, air-

cooled motor with cylinder 105 millimeters (4.09 inches) bore, rated at 20 horsepower, weighing 36 kilograms (80 pounds), which was strong enough to make the apparatus fly at Toury on May 31 and June 1 last.

On June 2 the machine was half destroyed and after being repaired it was sent back again to Issy on June 19, to make a brilliant flight of five minutes, followed on June 21, 22 and 23, by flights of eight, four, twelve, sixteen, five and thirty-six minutes. On July 4 the machine flew for 50 minutes and 8 seconds, and on July 13 it went on the cross-country flight from Etampes to Chevilly, 42 kilometers, or about 25 miles, in 43 minutes. M. Blériot then went to Baraques, near Calais, whence he made his great flight over the channel in competition for the *Daily Mail* prize of £1000 ($5000) offered to the first aëroplane to make this flight.

FIG. 3. FRONT VIEW OF BLÉRIOT MONOPLANE XI

### Features of Design

There are many features of the design of this machine which differ radically from the biplane type of machine that has been developed in the United States, and among these I may mention the single supporting plane, the absence of any steering planes or control in front, the locating of the propeller at the front, which means that the machine is pulled through the air instead of being pushed, the placing of the aviator's seat roughly midway of the length and behind the motor, so that the motor is constantly in view, concentrating the manipulation of the controls in a single "steering" post with a bell-shaped base, mounted on a flexible joint, to which are attached the wires for warping the wings and moving the vanes of the horizontal rudders—this feature is of utmost importance, for the arrangement is such that by holding the "steering" post vertical the machine automatically balances itself owing to the proper automatic setting of the various controlling surfaces to compensate for its motion if it tips upward, downward or to either side—the distribution of weight so that the center of gravity is some distance below the main plane, the use of aluminum as one of the principal materials of construction, and the high weight factor, namely 4½ pounds per square foot of supporting surface. As a corollary to this last feature the speed is, of course, very high, ranging from 30 miles per hour up. This speed is necessary for the machine to lift.

### General Dimensions

The Blériot machine is very small, only about one-half as wide from tip to tip as the Wright machine, and considerably shorter than the Curtiss machine. Its over-all length from tip to tip of the supporting plane is 23 feet 6 inches. The total length from front to back is 23 feet 3 inches. The main plane has 161 square feet of surface; the total weight including the aviator and gasolene for three hours' flight is 715 pounds, giving the factor which I have mentioned above of a flying weight of 4½ pounds per square foot of supporting surface. This factor is nearly twice the similar factor for the Wright and Curtiss machines.

### The Main Supporting Surface

The main planes, or wings as they are called, are built up of wooden spars connected by curved ribs, some of which are wood, others of aluminum. The cross-section of these spars is 3 inches by ¾ inch. The wood is ash; the trussing or ties are of piano wire and the covering is rubberized linen. This fabric is placed on both sides of the planes, so that each wing has roughly a crescent section, with a maximum thickness of about 3½ inches, 2 feet back from the front, the total width being about 6 feet.

These wings are detachable, and each is a unit in itself. The front spar projects about one foot beyond the inner end of the part of the wing covered by fabric, and fits into an aluminum socket, which is secured to the main frame of the machine. The outer end of each wing is rounded, as can be seen in illustration, Fig. 3. Above the wing, and in front of the aviator, is a triangular steel truss from which the wings are stayed. The wings are also stayed from the framework of the motor.

### The Body

The main frame, or body of the machine, is of a rectangular girder construction, as can be seen by referring to Figs. 4 and 5, which, however, are not views of the machine which flew the channel, but of another Blériot machine of a larger size. Yet the scheme of construction in general details is identical with the smaller machine which made the marvelous record.

This girder frame is made of ash and poplar, trussed with piano wire in the manner shown. It weighs 20.5 kilograms (45 pounds), is 7 meters (23 feet) long, and can easily carry a weight of 300 kilograms (660 pounds). In its forward end is framed the motor, and bearing for the propeller

shaft. Above at the front are attached the wings forming the main plane, and at the rear are attached the tail vanes and vertical rudder.

For support the girder frame is slung by four india-rubber springs from the fore carriage, which has two pneumatic-tired wheels. These wheels weigh 30 kilograms (66 pounds) with their attachments.

This detail is best seen by referring to Fig. 6. Similarly the rear of the body is carried on a single wheel, best seen in Fig. 4.

### The Horizontal Tail

The horizontal tail, or equilibrator, is built up of three planes, each of which is constructed in general in the same manner as the main wings, or supporting surface.

### The Vertical Rudder

A small vertical rudder is placed above the main tail plane. It has an area of 4½ square feet, and is pivoted around its front vertical edge. This pivot is 1 foot 6 inches from the edge of the large horizontal plane of the tail. This vertical rudder is controlled by a pedal device, while the pivoted tips of the horizontal tail and the warping of the wings are controlled by a lever in reach of the left hand of the aviator. The right hand of the aviator is free to care for the engine.

### The Propeller

The propeller, which can be very well seen in the illustration, Fig. 3, is directly in front, and is, in fact, the foremost part of the machine. Its axis is placed high, well toward the under side of the main supporting surface. It is two-bladed, and has a diameter of 6 feet 7 inches, and a variable pitch so formed that the air at the hub is thrown outward. It is composed of wood, walnut, glued up in layers, and weighs only 10 pounds. At the hub it is reinforced by a flange, and is attached directly to the crank shaft of the engine.

### The Engine

The engine, which is direct connected to the propeller as I have stated, has three cylinders and a rating of 20 horsepower. The cylinders are about 4 inches in diameter with a stroke of about 4¾ inches. They are air cooled, have automatic inlet valves and mechanically operated exhaust valves. Splash lubrication is employed and the carbureter is of a common design. The speed of this motor when used by M. Blériot in his flight was from 1200 to 1400 revolutions per minute, while its rating is at from 1600 to 1700 revolutions per minute.

It is interesting to note that this motor was built by Anzani, a native of Milan, Italy, who has his works in Paris. M. Blériot's aëroplane factory is at Puteaux and has been in operation about six months.

This monoplane is actually the simplest flying machine ever made; the control is exceedingly easy as all the elements of control converge to the same place. The wings can be folded up and the machine towed behind an automobile over the road for any distance.

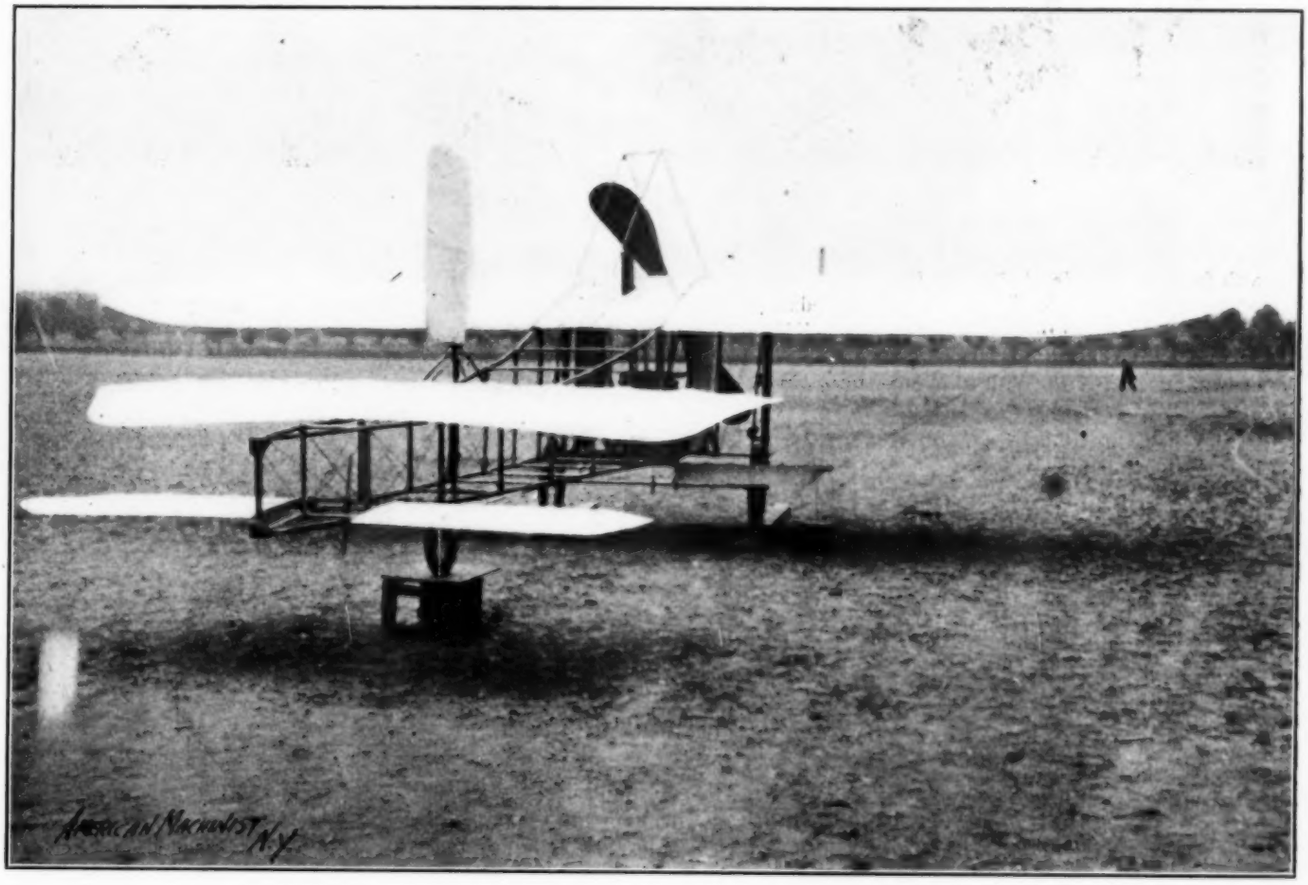


FIG. 4. REAR OF BLÉRIOT MONOPLANE XII

The large upper stationary tail plane is 11 feet 6 inches long by 2 feet 9 inches wide, and is attached on top of the girder frame at the rear. Two other small planes are located below this larger plane, and on a level with the lower edge of the body girder. Each of these smaller planes is pivoted at its front edge, and they can be operated independently. They serve the same function as the front control or front rudder in the Wright machine; that is, for elevation. In connection with the use of these planes and in the obtaining and maintaining of equilibrium, the main wings can be warped.

### The Channel Flight

As a matter of record it should be stated that the channel flight which took place in the early morning of July 25 last, covered an estimated distance, over the course taken, of about 25 miles, with an elapsed time of 37 minutes, or at the rate of about 40 miles per hour. The machine landed successfully on the English shore with only slight damage to the

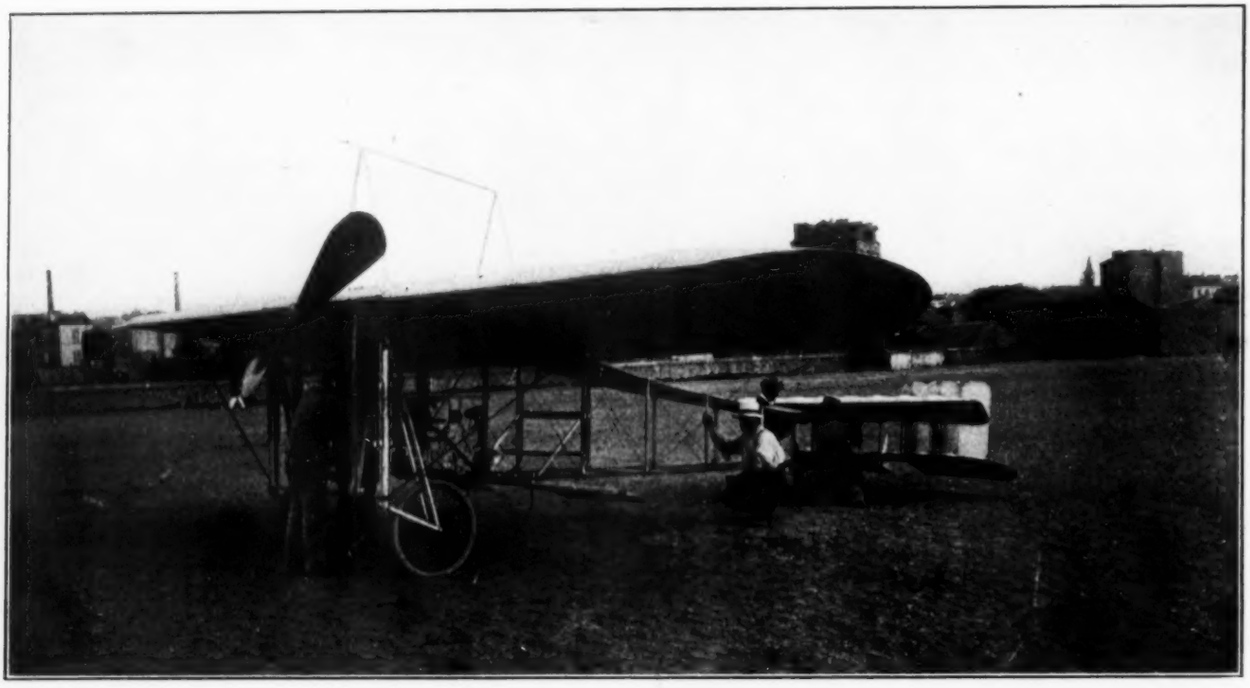


FIG. 5. PARTIAL SIDE VIEW OF BLÉRIOT MONOPLANE XII

wheels and undergear, although it glided to earth from an altitude of about 65 feet.

### BLÉRIOT MONOPLANE NO. XII

The machine used in the channel flight is known as No. XI. With the purpose of better showing the monoplane type the illustrations, Figs. 4, 5 and 6, have been introduced. They are of Blériot machine No. XII, a larger machine than the No. XI. In fact, while the No. XI machine can carry but one person, the No. XII machine has successfully carried three persons.

This machine was planned in March, 1909, and built in May. It was taken out for the first time on May 25 and left the ground immediately with

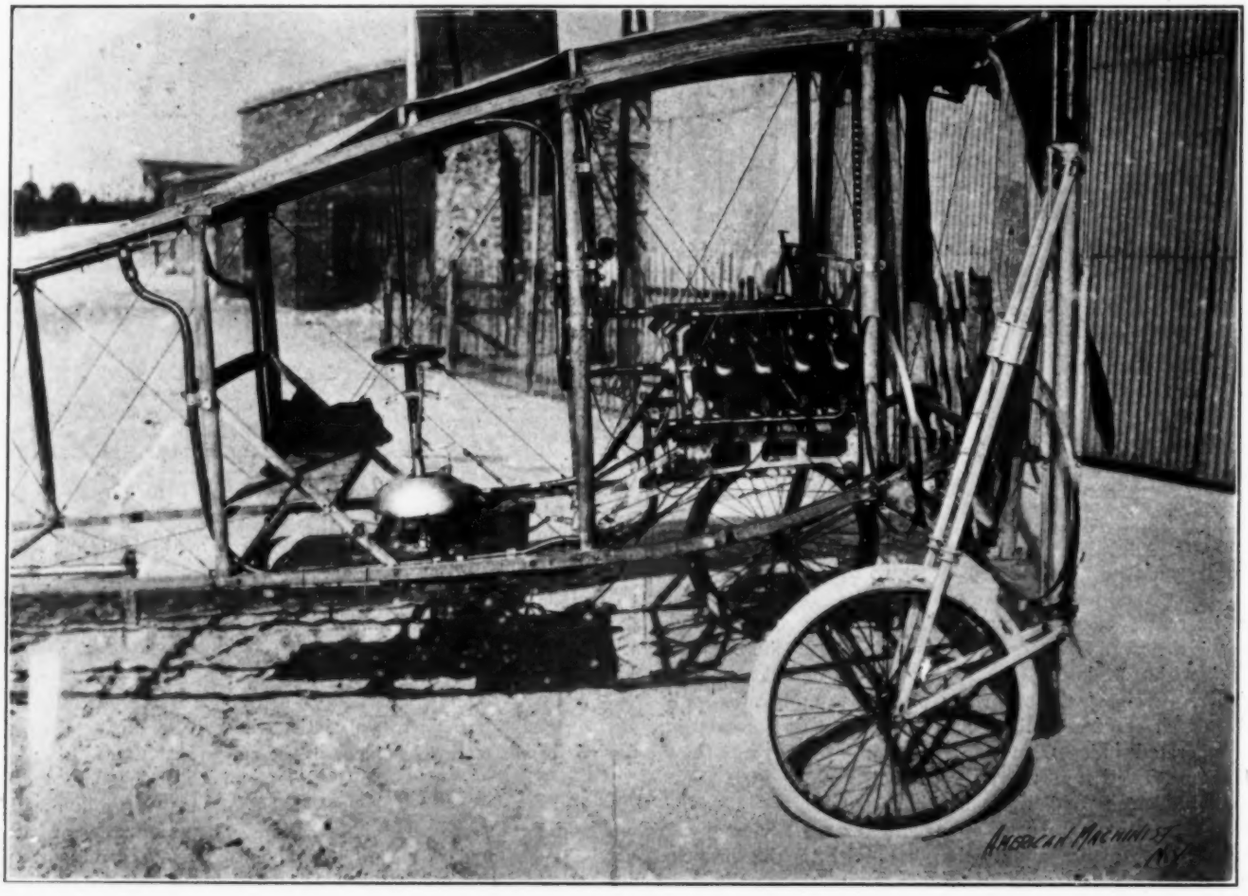


FIG. 6. POWER PLANT OF BLÉRIOT MONOPLANE

the motor making 1400 revolutions per minute, while it is capable of making 2100. The existence of this excess of power has been proven by his flight on June 12 with A. Fournier and M. Santos-Dumont as passengers. The weight of the machine is 350 kilograms and with the addition of the passengers and fuel there is a total of 560 kilograms or 1235 pounds. It took a long time to adjust all the controls as it was a very delicate process, and it was scarcely finished before June 15. Then in full control of his apparatus M. Blériot flew alone and with another passenger for flights of six, eight, twelve, twenty and forty-seven minutes.

This monoplane, No. XII, is distinguished in the long series of machines built by M. Blériot by three special characteristics:

1. The center of gravity is located 60 centimeters (23½ inches) under the center of support.

2. The propeller is geared down in the ratio of 36 to 14.

3. It can carry more than one passenger.

The first point is the most important for it does away with the old objection of the instability of the monoplanes. In fact a weight of 550 kilograms (1210 pounds) with a leverage of 60 centimeters (23½ inches) defies a strong wind and prevents capsizing.

It is interesting to refer to the experiments of Vuia and Santos-Dumont, who in 1907 built and experimented with monoplanes with a suspended center of gravity. It is also interesting to note that the rival of Blériot, the Antoinette monoplane of Latham, gets its stability by the very opposite process. They tried in the Latham monoplane to make the center of gravity and the center of pressure coincide and the speed alone keeps the apparatus in equilibrium.

There are two different schools of monoplane construction which are starting now, and the differences which exist between them are greater than the differences between the monoplane school and the advocates of the biplane, which the public is just now inclined to compare and consider as to their relative merits. The relation of these two centers, the center of gravity and the center of support, is often the same in the biplane as it is in the monoplane.

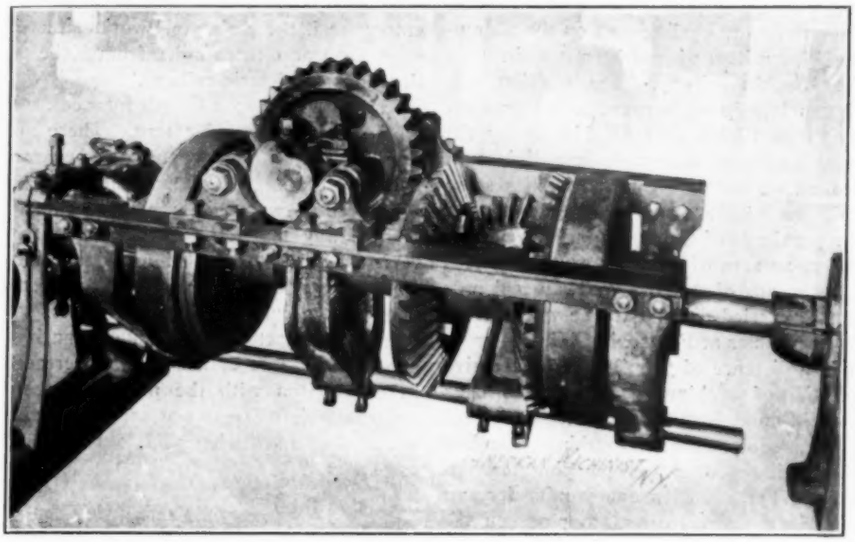


FIG. 1. GENERAL VIEW OF AUTOMATIC FRICTION REVERSE

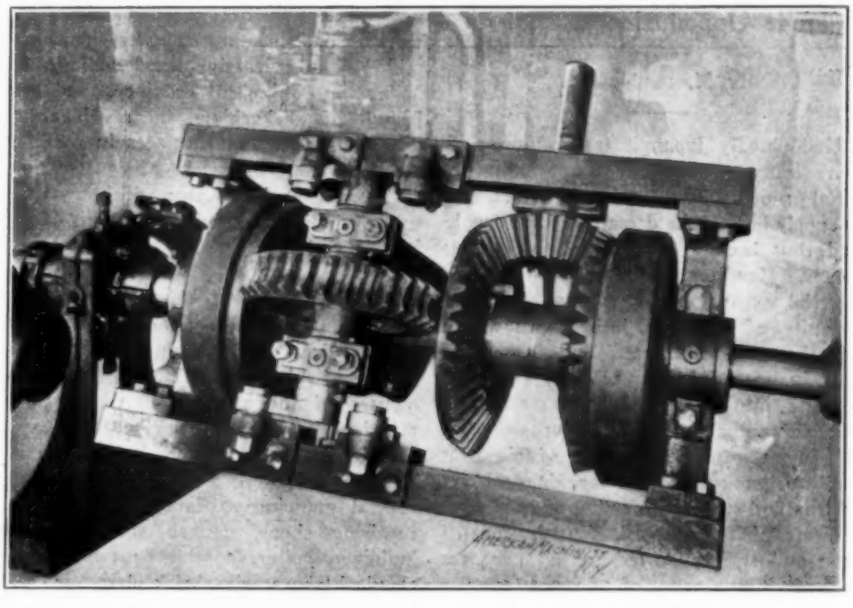


FIG. 2. ANOTHER VIEW OF AUTOMATIC FRICTION REVERSE

The surface of the Blériot No. XII is 9.5 meters (31 feet) wide, and 2.4 meters (7¾ feet) deep. It presents 22 square meters (237 square feet) of continental rubber cloth for support. The motor used is an E. N. V., eight cylinders, 85-100, giving 35 horsepower at 1500 revolutions per minute for a net weight of 77 kilograms (170 pounds). The propeller is 2.7 meters (8¾ feet) in diameter, and geared 36-14.

The control is the same as in the No. XI. The vertical rudder, which previously was at the rear, was too delicate, and was brought on top of the equilibrator or rear wings. The weight of the apparatus empty is 320 kilograms (705 pounds), and it has flown with 240 kilograms (529 pounds) of extra weight, three passengers, oil, water and gasolene.

Learning how to handle an aëroplane like this is rather a delicate matter, owing to the pendular movements resulting from every exterior force, wind, centrifugal force, speeding up and slowing down, steering and equilibrating or balancing.

## An Automatic Friction Reverse

By W. J. Kaup

The Philadelphia Gear Works, of Philadelphia, Penn., has just completed for P. E. Clark, of Elkins, W. Va., a power transmission and reverse that differs from the general type of machines for this purpose, in that the whole frame floats through the medium of cams, and reverses the mechanism silently and without jar. The machine consists of a sliding frame or dynamometer, upon which all of the mechanism is attached, as shown in the general view, Fig. 1, showing machine in operating position.

The sides of the frame are built up of angle iron connected at each end with bracket castings. Through the lower end of this frame is carried the guide shaft. The upper or central bearing carries the main drive shaft upon which is carried the operating mechanism. Fig. 2 shows the bevel-gear drive engaged in two bevel gears that run idle on the main shaft, one of these bevel gears carrying part of one of the clutches on its face. The two

clutches which are shown at either end of the frame in the top view, Fig. 2, are constructed with bearing ends which act as bearing for the whole frame; these clutches are keyed to the main drive shaft, and consequently rotate in the same direction always.

On the main drive shaft is carried a worm, which engages in the worm wheel on top. This worm wheel is carried by an independent yoke which is fastened to the bottom or guide shaft. The spindle upon which the worm wheel is carried has attached to it at each end a cam, these two cams acting against the rollers which are carried on the sides of the frame, causing the frame and clutch floats to move backward and forward according to the position of the cam.

### Operation

The main drive shaft gets its rotary motion through the bevel gears, which are designed to be motor driven, with variable speeds. This, in turn, through the medium of the worm and worm wheel, rotates the cams. This worm-wheel shaft is carried in independent yoke in various types of machine construction, particularly planers and shapers. The design as at present constructed gives about 40 horsepower, using vulcanized-fiber clutch faces. It is simple in principle and can be made at low cost.

## Trade Opportunities in Japan

By M. de Moreira

Undoubtedly Japan is trying more and more every year to buy fewer manufactured products from foreign countries, and to supply herself the demands of her people and thus become a great manufacturing center. Her great military, naval and industrial expansion calls for an immense quantity of iron, which her own mines and those of Korea cannot meet.

It is impossible to ascertain the total imports into Japan of iron, machinery, etc., for military and naval purposes, but the imports of 488,434 tons of pig iron and steel, together with machinery made of iron and steel to the value of $7,084,470, indicate that the total consumption of iron and steel imported for all purposes will reach an amount of 1,000,000 tons per annum. This ought to greatly encourage American manufacturers of machinery, as it shows the dependence of the country upon foreign imports of raw and manufactured products.

### The Imperial Steel Works

Japan steel works are quite important, and a description of the Imperial iron and steel works at Wakamatsu is of interest. These works were opened in 1901, 10 years after the definite proposal of the government for the establishment of a model iron and steel works which would render Japan independent of foreign countries for her supply of iron and steel manufactures. The area of the works is about 330 acres, including some 82 acres of ground recently purchased for the purpose of enlargement and not yet built upon. The situation is Yawatamachi, Onga-Gori, Chikuzen province, in the northwestern district of the island of Kiushiu. It is quite close to Wakamatsu, the chief port for the export of Kiushiu coal and about nine miles west of Moji, the well known coaling port on the Shimonoseki straits and northern terminus of the Kiushiu railway. The position was chosen largely on account of its proximity to the Chiku-Ho coalfields, by far the most extensive coal-producing district at present in Japan. This district lies some 30 miles to the south of Wakamatsu, in the provinces of Chikuzen and Buzen, and covers an area of over 300 square miles.

By means of a branch railway coal now can be carried directly to the works from its own mines at Futase, in Chikuzen province, a distance of 30 miles. An extensive addition of machinery is about to be made at this mine, including an electric power house, equipped with turbines, surface condensing plants, and pumping machinery. What a golden opportunity for our American manufacturers to place on the Japanese markets the result of their up-to-date products!

The present output from the mines is not sufficient to meet the demands of the works, supplementary supplies being obtained from privately owned collieries at Miike, in Chikuzen province, and the island of Takashima, near Nagazaki. There are two blast furnaces in working order and one in course of construction, to be completed this year. The two furnaces now in use produce 300 tons of pig iron in 24 hours, one giving 175 tons and the other 125 tons. The ore used at the furnaces is hematite. About 80 per cent. of this ore comes from the Dayen mines, near Henkow, in China, under special contract with the Hang Yang iron works, owners of the mine. There are three principal departments in the work, viz., the pig iron, the steel and the rolling mill. Besides this there are electric buildings, central pumping station, iron foundries, repairing shops, pattern shops, storage buildings, boiler shops, chemical and mechanical laboratories, brick plant, etc.

There are at present two bessemer converters with a capacity of 100 tons each per 24 hours, one charge amounting to 20 tons. In three years' time a third plant will be completed. There are now eight Siemens-Martin furnaces, putting out about the same quantity of molten steel per 24 hours as the two bessemer converters. A great part of this steel is taken in five-ton ingots directly to the plate mill.

Under present conditions the works are able to turn out about 90,000 tons of finished material a year. The original plans were for an annual output of 60,000 tons, which would have satisfied one-half of the demands of that time, but the success of the venture and the steady increase of government requirements have brought about a sensible extension of the original program. In the course of the next few years the annual output will easily be double the present actual output. It is to be noted that practically all the material for the building of ships of war are now turned out at the works.

Another steel works, but of a private enterprise, is the Kobe steel works situated near Kasugano, three miles from Kobe on the Hanshin electric railway.

They use acid open-hearth furnaces, one of 8 tons and one of 5 tons. There are three steam hammers and two electric traveling cranes. Most machinery turned out at these works is mining machinery and railway material. In a comparative review of the imports of machinery into Japan, an Osaka newspaper comments upon the peculiarities of the times. It refers to the fact that the value of machinery imported in 1907 has greatly increased in comparison with the preceding years and that this increase was still more pronounced in 1908, whereas it ought to decrease.

### Japan's Needs

What the Japanese need most are lathes, and machines for metal-working, electric and steam works; spinning, dyeing, mining and smelting machinery; surely it lies with the American manufacturer if similar machinery sold in Japan will be of American or English make.

### Japan's Exports

Japan, however, exports a great deal of machinery of her own make, and this fact is most remarkable when one realizes that iron and steel necessary for making this machinery must be imported from foreign countries.

### Railway Construction

In what concerns railways the Japanese buy a good deal of their road-building machinery and machine tools in England. Still, Americans were the first to build railways in Korea, starting with the Seoul-Chemulpo line. During the next five years there will be expended over $2,000,000 in the construction of a railway for about 100 miles along the east coast. There are also being constructed by the sugar mills in South Formosa about 300 miles of sugar-cane tramways. The government has also granted the privilege to construct a railway in the Arisan lumber district, and it will connect Kagi city, on the government trunk line, to the summit of Mount Ari, some 7000 feet above the sea level. To carry this road from Kagi at sea level 40 miles to its mountain terminus will require the construction of 90 tunnels and the expenditure of nearly $2,000,000.

The new 27-mile narrow-gage line from

East Kangawa, on the Tokyo bay, to Hachioji is entirely equipped with American cars and engines, but the machinery used to construct the road is either Japanese or English. American manufacturers have, nevertheless, more opportunities, if they will only avail themselves of them to sell their products on the Japanese markets, but they do not follow up as closely as their competitors, nor do they have as good connection on the ground as the English. The development of the electric industry has followed the pace with the rest of the progressive moves Japan has made in industrial lines. The Tokyo Electric Light Company is going to enlarge the scope of its business by establishing a second power station. The work of the construction is estimated at more than $5,000,000, and it is believed that the station, when completed, will be capable of supplying electric current to the extent of 35,000 horsepower.

Most wonderful of all has been the growth of the electric tramway systems throughout the empire. The first electric tramway system opened in Japan was in 1895 at Kioto. Since then every city of any importance has in succession constructed electric tramways so that now there exist over 16 electric tramway companies with an aggregate capital of $40,000,000 operating 165 miles with about 100 more miles under construction. Besides these 16 companies there are 15 others which are not yet in working order. There is also the Osaka-Takaradzuka electric railway of 15 miles, and the Minomo-Arima branch, which will be constructed at the cost of over $1,000,000.

If there is anything in which American manufacturers surpass the English it is surely in the electrical field, and it is to be hoped that opportunities like those just mentioned will not pass unperceived. The fear that some of our manufacturers seem to have is that the Japanese will not live up to their contract. In other words, that they are tricky. I do not think that this opinion is general; I have heard it, though, from many important manufacturers. Japanese are tricky like every intelligent race, and no more. They are tricky in obtaining information from others and giving none in exchange, but they respect their business contracts, if no other, and are too much a progressive nation not to appreciate the value of business honesty.

---

Reports from builders of steam-shovel and dredging machinery, according to *Steam Shovel and Dredge*, show that electricity as motive power in operating steam shovels and dredges has gone beyond the experimental stage, and that in the future operation of steam shovels and dredges electricity is going to play a very important part. In the Western States, especially where water power is available, a great many steam shovels and dredges are being installed and equipped with motors to be operated by electricity.

# Testing Gear for Automobiles

By M. E. Hidiegan

During a recent visit to the works of the Thomas B. Jeffery Company, makers of the Rambler automobile, located at Kenosha, Wis., I was interested in some of the special machines, tools, jigs and appliances designed and built in this shop. These were a departure from the common shop practice in the construction of machines, tools, etc., for special use only. Each gives evidence of thought and study in the designing, and an examination of the machines shows that the designer's ideas have been followed by workmen who are experts in the building of special machinery. Before leaving the special-machine construction shop, each machine is given a thorough test so that when turned over to the department for which it is intended, it cannot fail to produce accurate work, even with the inexperienced operator.

In the gear-cutting department there are a number of special machines, gages and calipers, together with the regular machines made for gear cutting. As an extra precaution against the possibility of allowing any but correct gears to slip through the inspection department, a system of gases is used that will instantly detect any inaccuracy up to 1/3000 part of an inch. These gages never leave the foreman's office wherein all inspection is done, the machine operator being furnished with a special gage that takes care of the work he has in hand.

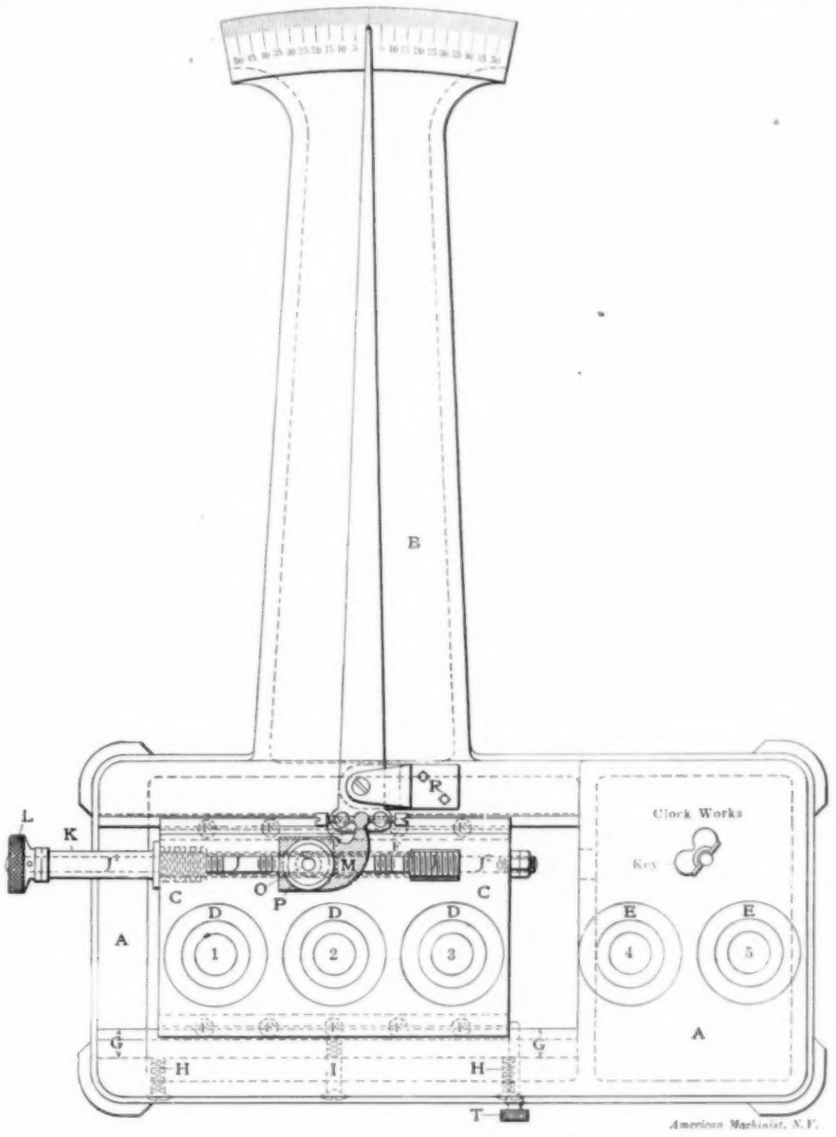



FIG. 1. AN ACCURATE DEVICE FOR TESTING SPUR GEARS

The accompanying sketches show a device for the final testing of all spur-cut gears, either soft or hardened. Any tendency to change from a round to an oval will be instantly detected by this device, and a variation from 0.0003 to 0.0005 will be sufficient to reject the gear. A study of this device will show also to what extent the designing and building of these special tools, jigs, etc., is carried on.

The base is cast iron of neat design, light, yet sufficiently strong to insure stiff-

ness. Projecting from the back is an arm which is a part of the base; at the outer end is a graduated plate reading in the thousandths. The base has a machined opening in which is fitted a reciprocating carriage. In this carriage are tapped holes to receive a steel stud for a master gear. The base also has tapped holes to receive a similar stud for the gear to be tested.

In Fig. 1 *A* is the base plate, *B* the extending arm, *X* graduated plate reading in the thousandths; *C*, the gear stud carriage; *D D D* and *E E* are the position of the gear studs as required according to the diameter of the gear; *F* are 10¼-inch steel balls held in place by a retainer made of sheet brass. The base and carriage has V-grooves to receive the steel balls that take the place of flat sliding surfaces, thus eliminating all friction and giving a positive and sensitive reciprocating movement to the carriage. *G* is an inserted steel piece, which provides for adjustment in case of wear; it has a V-groove to receive balls, the base is drilled and tapped to receive screws *H H* and screw *I* passes through the drilled hole in the base and into a tapped hole in the insert piece *G*. These screws provide a means for securing and adjusting *G*.

*J* is a gage or adjusting screw, the design of which is clearly shown in Fig. 2. It is ⅜-inch machine steel and has 24 threads per inch. The end $J^1$ is reduced to ¼ inch to fit loosely in the sleeve *K*. $J^2$ is reduced to fit loosely in the carriage, the end being threaded to receive adjusting and locknuts. *K* is a brass sleeve turned and threaded at one end to screw into a tapped hole in the carriage; through the center is drilled and reamed a ¼-inch hole fitting loosely over $J^1$. *L* is a nurled nut secured with a pin through $J^1$. *M* is a machine-steel piece shaped as in Figs. 1 and 2, having a turned portion, the end of which is almost round; the bottom has a dovetail piece fitted to a dovetail slot in the carriage. *N* is a one-fourth section of a nut. *O* is a stem and is in one piece with nut *N*. The stem passes through a hole in *M* and is threaded to receive nurled nut *P*.

The index hand or pointer is made from sheet aluminum. This answers the purpose much better than if made from sheet steel or brass, for when a large gear is being tested with a small master pinion, more or less vibration or quivering goes on at the outer end of the index. For this reason the index hand must be of light stiff stock.

At the fulcrum end of the index hand are two ¼-inch steel studs having tapped holes for ⅛ inch hardened adjusting screws. *R* is a brass bracket secured to the base, having a countersunk hole in the bottom to receive the lower end of the spindle and a tapped hole at the top to receive countersunk nuts for the spindle upper bearing. *S* is a short spindle shaft with a short threaded portion to receive the aluminum index hand, also locking nuts. *T* is a stop pin, the purpose of which is to prevent the carriage flying back when the gear is removed from the spindle. The base has eight holes for this stop pin.

To provide an even tension on the carriage whether testing small gears, or those at its extreme capacity, was the cause of some study. The works of an old alarm clock were placed and secured in a pocket made for the purpose in the corner, as indicated. The key protruded up through the top of the base, one end of a wire cable was attached to the clock work, the other end to the carriage. Any desired tension could be had by simply winding up the works the same as if winding a clock.

Let us suppose studs are in 3 and 5 ready to test the spur gear on stud 5 with master pinion on stud 3. By revolving the gear on stud 5, the test will be recorded as described in the first part of the article.

A neat and practical device is shown in *N M P* in the vertical section, Fig. 3. In this view the nut *N* is engaged with adjusting screw *J*. After the gears are set correctly on studs, any variation of the index hand from 0 (zero) on the graduated plate can be quickly corrected by turning adjusting screw *J* until the hand points to 0 (zero). This being done, the gage is set ready for testing. The action of the spring locks *M* by pressing the dovetailed piece up and at the same time pressing down on *N*, holding it in the threads in *J*. Turning the nut *P* down disengages *N* and releases the dovetail in *M*, leaving the carriage free to move 2½ inches without disturbing the index hand.

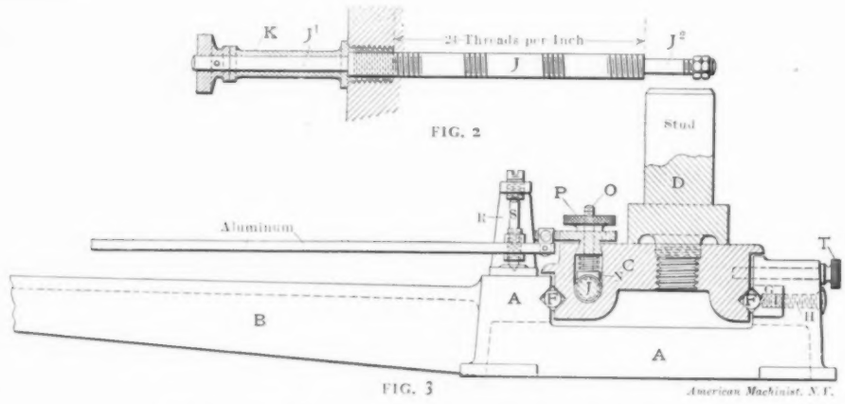



FIG. 2. DETAILS OF TESTING DEVICE FOR SPUR GEARS

## Personals*

H. J. Guttman, until recently general foreman of the Automatic Electric Company, Chicago, Ill., has resigned his position to engage in business for himself.

J. C. Stark, formerly with the Courier Koeth Manufacturing Company, has accepted a position as superintendent of the Western Wire Goods Company, of Buffalo, N. Y.

Arthur T. Dowd, for some time connected with J. G. White & Co. as construction engineer, has become mechanical engineer with the Hale-Kilburn Metal Company, Philadelphia, Penn.

Royal R. Keely, formerly city engineer at Edmonton, Alberta, Canada, has recently accepted the chair of professor of electrical engineering, Nova Scotia Technical College, Halifax, N. S., Can.

Frederic H. Leland, who has done considerable work in introducing shop organization and increased production methods, has recently established himself as a production engineer in Marberth, Penn.

Robert G. Pilkington, one of the first engineers in this country to make a specialty of the design of gasolene commercial motor cars, has been placed in charge of that class of work for the Studebaker interests in Detroit.

H. D. Penney, formerly inspector of tools, jigs and fixtures with the Remington Arms Company, Ilion, N. Y., has resigned to accept a position as tool and fixture designer with the Toledo Motor Company, Toledo, Ohio.

Fred H. Vose has joined the mechanical engineering department of the Case School of Applied Science, Cleveland, Ohio. Mr. Vose was formerly assistant professor of mechanical engineering at the Washington University.

Burns D. Lockwood, until recently mechanical engineer of the C. C. C. & St. L. railway, has become associated with the Pressed Steel Car Company, McKees Rock, Penn., where he will act in the capacity of assistant chief engineer.

George H. Wadsworth, superintendent of the Falls Rivet and Machine Company, Cuyahoga Falls, Ohio, sailed on August 18 for Europe on a combined business and pleasure trip. In his sojourn Mr. Wadsworth will visit England, Scotland, France and Germany in the interests of his company.

*Items for this column are solicited.

## Captain Herman B. Schuyler

Captain Herman B. Schuyler, assistant treasurer of the General Electric Company, in charge of credits and well known in financial circles throughout the country, died on August 14, aged 67 years.

Prior to his connection with the General Electric Company, sixteen years ago, Mr. Schuyler had held several important positions with large commercial institutions, and through marked ability he was appointed to the important place he held at the time of his death.

Mr. Schuyler served with distinction during the civil war and remained with the army department until 1870. It was as the result of this service that he secured his military title.

## Forthcoming Meetings

**International Association for Testing Materials, fifth congress, Copenhagen, Denmark, September 7-11.**

**International Association of Machinists, biennial convention in September, Denver, Colo.**

**Brotherhood of Railway Carmen, biennial convention in September, Atlanta, Ga.**

**National Machine Tool Builders' Association, fall meeting, October 12 and 13, New York City. P. E. Montanus, secretary, Springfield, Ohio.**

## Business Items

The Crocker-Wheeler Company, Ampere, N. J., will open an office in the Ford building, Detroit, Mich., on or about September 10. Charles W. Cross will be the manager of this branch.

The Bullard Machine Tool Company, of Bridgeport, Conn., owing to the rapidly increasing demand for their vertical turret lathes and boring and turning mills, have had to build an addition to their works. Contracts for the building were placed last week and the orders for the new equipment have already been placed.

The Colburn Machine Tool Company, of Franklin, Penn., builder of vertical boring and turning mills, announces that after September 1, it will be represented in the Chicago territory by the E. L. Essley Machinery Company, of 62 West Washington street. Charles M. Robertson, formerly superintendent of the plant of the Colburn Machine Tool Company, will be associated with the Essley Company as special representative and expert.

The Garwood Company announces that it has appointed the Tucker Electric Company, of 970 Old Colony building, Chicago, as its selling agent for the city of Chicago, and as far south in Illinois as a line drawn east and west through Springfield, and including Springfield and as far in Wisconsin as a line drawn east and west through Madison and including Madison, and that portion of Indiana north of a line drawn east and west through Indianapolis and including Indianapolis.

## Business Opportunities

The Michigan Casting Company (Flint) is enlarging its factory.

The Waterloo (Ia.) Drop Forge Company is to erect a new plant.

The Badger Auto Company will erect a building at Columbus, Wis.

The Racine Manufacturing Company, Racine, Wis., will erect an addition.

The Walter Cabinet Company, Mayland, Mich., is erecting a large factory.

The National Wood Pipe Company will erect a large factory in Portland, Ore.

The Brazil Bottle and Glass Company will erect a large plant in Brazil, Ind.

The Buick Motor Company, Flint, Mich., will erect an addition to its plant.

The Grupe Boiler Factory, Davenport, Iowa, will erect an addition to its plant.

Rogers Silver Plate Company, Milford, Conn., is to erect an addition to its plant.

The Winona (Minn.) Launch and Engine Company will move to La Crosse, Wis.

The building of the Cortland Barrel Works, Cortland, N. Y., was destroyed by fire.

The Standard Separator Company, of Milwaukee, Wis., will erect a large factory.

The Gary Motor Car Company is to occupy large new quarters in Muskegon, Mich.

American Radiator Company will erect an addition to its Springfield, Ohio, plant.

The Paramount Knitting Company, Chicago, Ill., is erecting an addition to its plant.

The saw, planing and gin mill of R. Eaton at Darburn, Miss., was destroyed by fire.

The Owosso Knitting Company will build an addition to its plant at Owosso, Mich.

The Pacific Coast Gypsum Company, Tacoma, Wash., is to erect an addition to its plant.

Globe Chemical Company, Cincinnati, O., is enlarging its plant at St. Bernard, Ohio.

The Bettendorf Metal Wheel Company, Springfield, Ohio, will build a large addition.

The Naumkeag Steam Cotton Company, Salem, Mass., is putting up a new building.

Oscar Lear Automobile Company will erect an addition to its plant in Springfield, Ohio.

The National Foundry Company, Providence, R. I., is soon to establish its plant at Warren.

The Joliet Steel Car Manufacturing Company is about to construct a very large plant.

Melin & Winkel, South Haven, Mich., are erecting a factory for the manufacture of pianos.

The Owens Bottle Machine Company, Toledo, Ohio, will erect a large plant in Fairmont, W. Va.

Work on the new roundhouse of the Vandalia Line at Terre Haute, Ind., is rapidly progressing.

The Kissel Motor Car Company, Hartford, Wis., will erect another large addition to its plant.

The Menasha Paper Company, Menasha, Wis., will erect a paper mill at Ashland, Wis.

The Brockton Welting Company, Brockton, Mass., is to erect a 3-story addition to its plant.

Hess Spring Axle Company, Cincinnati, Ohio, is enlarging its plant and will install new machinery.

A. J. Raymond Sash and Blind Works, Athol, Mass., will enlarge its plant by a 126-foot addition.

The Hawkeye Pearl Button Company, Muscatine, Ia., is to build an extensive addition to its plant.

The E. R. Thomas Motor Company, Buffalo, N. Y., will erect a large addition to its present plant.

Henry R. Wyckert, of Council Bluffs, is planning the erection of a new tent and awning factory.

Smeaton's Saw Mill at Ashland, Wis., was completely destroyed by fire. Loss, about $19,000.

The Davenport Wagon Company, Davenport, Iowa, contemplates the erection of a $52,000 building.

The Keystone Tube Company, Pittsburg, started building its new factory at Queens Junction.

The Central Textile Corporation, Memphis, Tenn., is to build a large cotton mill in South Memphis.

The Barre Wool Combing Company, Barre, Mass., is to construct a large woolen mill in that city.

Dean Novelty Company, Putnam, Conn., is soon to install machinery for the manufacture of needles.

The Standard Wash Tray Works, New Haven, Conn., propose to build a large plant with modern equipment.

Oxford Linen Mills, North Brookfield, Mass., have drawn plans for a large plant to employ 4500 hands.

The Diamond Lumber Company, of Greenbay, Wis., has let contract for the construction of a new sawmill.

The Monongah Glass Company, is planning to erect a new factory in Fairmont, W. Va., where it is now located.

The Massachusetts Mohair Plush Company, Lowell, Mass., is to erect a new mill for manufacturing purposes.

The Bibb Manufacturing Company, Columbus, Ga., is to purchase further machinery for several of its mills.

The Nashua Manufacturing Company, Nashua, N. H., has started the erection of the addition to its cotton mills.

Fire totally destroyed the A. B. Hoffman & Son leather plant at Lynn, Mass. Loss estimated at $200,000.

The American Simplex Motor Car Company, South Bend, Ind., is to build a large addition to its present plant.

J. W. Wells (Menominee, Mich.) is about to start plans on a maple-flooring plant to be erected in that city.

The Martinsville Cotton Mill Company, Martinsville, Va., is in the market for motor equipment for its new mill.

J. Spaulding & Sons Company, North Rochester, N. H., are to erect a leather board mill which will employ 500 hands.

The W. W. Putnam Company, Staunton, Va., manufacturer of organs, is erecting an addition to their factory.

Hiram P. Yeager, proprietor of the Penn Boiler Works, Reading, Penn., is to shortly erect a new boiler works.

The Eagle Square Company, Bennington, Vt., is enlarging its power plant and will soon be in the market for boilers.

The Sin Clair Laundry Machinery Manufacturing Company, Chicago, is to establish its plant in Gibson City, Ind.

The Tennessee Coal, Iron and Railway Company, Birmingham, Ala., is to erect a plant for the manufacture of bolts and spikes.

The Columbus Manufacturing Company, Columbus, Ga., has let contract for the erection of a large addition to its cotton mill.

The Drew Carrier Company, Waterloo, Wis., is to increase its capacity by adding go-carts and small hand carriages to its line.

The Columbia Oil and Gas Company, of Huntington, W. Va., is making extensive improvements in its compressor plant.

The Tobin Arms Manufacturing Company is to erect a large modern plant in Woodstock, Ont., for the manufacture of small arms.

The United Soap Company, of Brantford, Canada, is reported to be negotiating for the erection of a large factory at Hull, Quebec.

The J. N. Wheeler Screen Company, Geneva, Ill., is installing new machinery for the manufacture of a new patented roller wash-board.

A large part of the Hendricks Brothers copper mills, Belleville, N. J., was destroyed by fire, with an estimated loss of over $100,000.

The Lehman Manufacturing Company, Beaumont, Texas, is to erect a plant for the manufacture of washboards, lawn swings and ladders.

The Dan River Power and Manufacturing Company, Danville, Va., has begun work on a

large cotton mill and is in the market for textile machinery, motor drive equipment, etc.

The Forged Steel Wheel Company, Pittsburg, Penn., a subsidiary of the Standard Car Wheel Company, has perfected plans and let contract for a steel plant at Butler, Penn.

# Want Advertisements

*Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.*

## Miscellaneous Wants

Caliper catalog free. E. G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed: automatic special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order: tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Dies designed, all kinds, with cost of making; practical working drawings; send sketch of model. Box 548, AMERICAN MACHINIST.

We design and build light machinery, including fixtures, jigs, tools, punches and dies, and model work. The Matson Machine Co., Bethel, Vermont.

Special machines for reducing the cost of production designed; inventions developed to a practical and commercial basis. Benj. Brownstein, mechanical engineer, Trenton, N. J.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Active Partner Wanted—Owner of plant located in large city in the Middle West, manufacturing hoisting machinery, brick-making machinery, pumps and other special lines, desires to withdraw from active business. Will sell all or part of his holdings to right man on very liberal terms. Box 491, AMER. MACH.

## Situations Wanted

*Classification indicates present address of advertiser, nothing else.*

CONNECTICUT

Systematizer and accountant desires position; experienced, energetic and capable; can install modern system of accounting and production that will produce results. Box 556, AMERICAN MACHINIST.

ILLINOIS

Tool foreman and designer desires change; 18 years' experience; technical education; capable as mechanical superintendent; at present employed. Box 557, AMER. MACH.

Position wanted by an experienced superintendent, expert in machine work and manufacturing; a good organizer; resourceful in designs and processes for increasing production; location not material. Box 537, AM. MA.

Mr. Manufacturer: Your manufacturing staff needs new life. Opportunity presents you, technical man, 19 years' experience, manufacturing, production engineering; holding executive position, manufacturing staff of large electrical works; desires change with manufacturer of electrical apparatus, adding machines or similar lines, superintendent or master mechanic; expert tool design, cost reduction. Box 568, AMERICAN MACHINIST.

INDIANA

Superintendent of forge shop on shape or drop hammer work; costs and weights from drawings; contract preferred; 20 years' experience. Box 569, AMERICAN MACHINIST.

MASSACHUSETTS

Superintendent, wide experience in manufacturing, desires change. Box 525, AM. MA.

Technical graduate, four years experience in shop and drafting room, wants position as draftsman or responsible position in factory or office. Box 566, AMERICAN MACHINIST.

MINNESOTA

Responsible position in the manufacture of gas engines and suction producers by designing engineer and expert. Sixteen years' experience; highest references. Box 539, AM. MACH.

MISSOURI

Position as general superintendent (west of the Mississippi), by exceptionally capable American, 38 years of age, married; have had varied experience on electrical, sewing machines, watch work, instrument, clocks and motor manufacturing in all their branches; can obtain highest quality and quantity of work from employees at medium cost; am at present employed. Box 553, AMER. MACH.

NEW JERSEY

Assistant to chief engineer desires change; experienced designer of machine tools and first-class man for general work; location immaterial. Salary reasonable. Box 559, AMERICAN MACHINIST.

NEW YORK

Position as general foreman by one who can improve facilities and get the work out. Address Box 540, AMERICAN MACHINIST.

Foreman, practical machinist, good estimater and handler of men, 16 years' experience in best of shops. Good reference; good reason for desiring a change. Box 545, AMER. MACH.

Superintendent open to engagement in October. Successful in increasing production and reducing costs in foundry and machine shop. Practical and executive. Box 524, AM. MACH.

Superintendent or general foreman up-to-date in manufacturing, expert; diemaker bread experience of 20 years; aggressive handler of help; hustler who can reduce cost; German, age 35; best references. Address A-1, Box 565, AMERICAN MACHINIST.

Wanted—Position as master mechanic or superintendent, vicinity of New York; exceptional mechanical and executive ability; thoroughly familiar with estimating and piece-work systems; expert in sheet-metal goods and tools for same; employed at present as master mechanic large works, but desires change. Box 554, AMERICAN MACHINIST.

Production engineer will contract on a bonus or commission to raise your output and reduce your costs within specified time, and have it so production can be maintained. Have done it for others. Why not have your efficiency looked up? No systematizing scheme, but real expert service. Write for further particulars. T. A. Campbell, 500 5th Ave., New York City.

Technical and commercial manager and mechanical engineer, American, twenty years' wide experience, desires change; skilled in details of modern methods in office, sales, drafting room, shop, foundry etc.; energetic, forceful, with quick comprehension; accustomed to heavy responsibilities and masses of detail; handled all departments of business of two millions annually; particularly posted on large and small gas and oil engines; highly endorsed; honest, able and loyal; seeks proposition from any desirable locality. Box 535, AMER. MACH.

PENNSYLVANIA

Superintendent or assistant superintendent, with 20 years of practical experience in large manufacturing concern, invites correspondence from parties desiring competent man. Have thorough experience in modern shop methods. Good character and ability. Best of references. Box 542, AMERICAN MACHINIST.

TENNESSEE

Superintendent with wide practical manufacturing experience, up-to-date on modern methods and factory costs. Box 558, AM. M.

## Help Wanted

*Classification indicates present address of advertiser, nothing else.*

COLORADO

An established company about to re-equip and greatly enlarge its plant, desires applications for the following positions: Factory superintendent, capable of taking entire charge of factory doing nothing but fine accurate work, but which must be done at minimum cost; general foreman, assistant to the superintendent; chief draftsman, preferably one with electrical experience; purchasing agent, cost clerk, shipping clerk, foreman for all machine parts departments; foreman for steel-pressing department; blacksmith foreman, who has had experience handling high-grade steels; foundry foreman, who can take entire charge of steel and iron foundry, and who understands the business thoroughly; cost estimator, who has had experience in all departments in this line. In sending applications kindly state fully and in detail all your qualifications, your specialties, if you have any, whom you have worked for, as well as whom you are working for now, salary expected, references and any other information which will help us in judging the merits of your application. The factory is located in one of America's most healthful and best locations and opportunities are limited only by employees' ability. Address Box 481, AMERICAN MACHINIST.

CONNECTICUT

Wanted—Foreman for hardening room of establishment in New England, manufacturing full line of small tools. One who has had experience in up-to-date methods and who has a thorough understanding of hardening and tempering in large quantities. Box 544, AM. MA.

Wanted—First-class die sinker for dies on heading presses, drop hammers and power hammers capable of taking any ordinary piece and making dies to reproduce it. Give experience, age, etc., and salary expected. Location is pretty New England village where living is cheap. Box 543, AMERICAN MACHINIST.

ILLINOIS

Wanted—Machinist foreman thoroughly experienced in milling machine work; location, west side, Chicago; give age, experience, present employment, and wages wanted. Box 562, AMERICAN MACHINIST.

INDIANA

Two experienced foremen for machine and assembling rooms, manufacturing gasolene motors. Give reference, experience and age. Box 262, AMERICAN MACHINIST.

Wanted—200 skilled workmen for manufacturing gasolene motors; new shop to be open about September 15; give experience and two references; state wages expected. The Western Motor Co., Marion, Indiana.

Wanted—An experienced foreman for machine department, one familiar with screw machines, drill presses, punch presses and milling machines for small accurate work; give reference and salary expected, to go out of city. Box 509, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—Assistant to head draftsman of manufacturing plant. One having had experience on automatic machinery preferred. State experience and wages expected. Box 532, AM. M.

Wanted—First-class valve salesman for Boston and immediate vicinity. State where last employed. Good opportunity for energetic and ambitious man. All communications strictly confidential. Address: The Fairbanks Company, Boston, Mass.

Superintendent wanted for a growing, up-to-date machine shop employing at the present time about seventy-five men; work is of medium weight and considerable variety; a man who has had actual experience in managing help on accurate manufacturing work will be well paid and stand good chance of advancement. In replying give full details as to experience and state pay expected. Box 561, AMERICAN MACHINIST.

MICHIGAN

Wanted—Automatic and hand turret machine operators. Apply Buick Motor Co., Flint, Mich.

Wanted—A few first-class toolmakers on small work; good wages and steady employment for competent men. Box 278, AM. MA.

Wanted—First-class milling machine and lathe hands; give age, experience and wages expected. Apply Buick Motor Co., Flint, Mich.

Wanted—25 first-class monitor hands and 12 assemblers. Apply by letter to "Superintendent," Detroit Lubricator Co., Detroit, U. S. A.

Wanted—Thoroughly competent foreman to take charge of grinding department employing 25 hands; must be a strictly first-class man. Apply Buick Motor Company, Flint, Mich.

Wanted—Engineer or machinist capable of laying out and designing motorcycles and of acting as master mechanic in a company now forming. Must be able to organize and direct men. Give references, experience and salary. Box 529, AMERICAN MACHINIST.

MINNESOTA

Wanted—Tool and metal patternmaker, familiar with the making of dies for pressed steel work in agricultural implement plant. Monitor Drill Co., Minneapolis, Minn.

NEW JERSEY

First-class man who understands carbonizing on pack hardening. Splendid opportunity for man who can handle help and produce results. Address "Carbonize," 794 Broad St., Newark, N. J.

Toolmakers—50 good men; permanent employment at good wages; comfortable shop and pleasant surroundings. Sloan & Chace Mfg. Co., Sixth avenue and South Thirteenth

street, near Roseville avenue station and D. L. & W. R. R., Newark, N. J.

Machinists—50 good men; permanent employment at good wages; comfortable shop and pleasant surroundings. Sloan & Chace Mfg. Co., Sixth avenue and Thirteenth street, near Roseville avenue station and D. L. & W. R. R., Newark, N. J.

NEW YORK

Wanted—Only first-class toolmakers on die and jig work. Bundy Manufacturing Co., Endicott, N. Y.

Draftsmen familiar with engine and boiler work. State age, experience in detail, references and salary expected. Box 570, AM. M.

Wanted—A few experienced switchboard and mechanical draftsmen; steady employment. Apply in writing, Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—Foreman toolmaker, experienced in manufacture of iron valves preferred. State age, if now employed, married or single, and wages expected. Location Central New York. Box 533, AMERICAN MACHINIST.

Manager of boat and engine works must go South, and offers $2000 of his holdings and position as superintendent to a hustler. The plant is in a small town on a beautiful river. Our trade is doubling each year. A better opportunity is seldom found. Address Box "P," AMERICAN MACHINIST.

Wanted—First-class mechanic to act as toolroom foreman. Must be capable of designing modern jigs, fixtures, gauges, etc., for small high-grade interchangeable parts. Good opening for energetic, progressive man with executive ability. Address "Mechanical Superintendent," AMERICAN MACHINIST.

Wanted—A young man in a machine tool sales department in New York; must be an efficient stenographer and have some knowledge of mechanical terms. A good position for a technical man who desires advancement in the mechanical branch of the business. Box 555, AMERICAN MACHINIST.

Lathe, planer and boring mill hands wanted for day and night shift; no labor troubles, increasing force; applicants must state wages desired, past experience, if employed at present, and the names of past employers, to receive further consideration. Application considered confidentially. Apply Ingersoll-Rand Co., Painted Post, N. Y.

Wanted—An expert all-around machinist and toolmaker who is ambitious to become a teacher of manual training and machine-shop practice. Must be American born with good education, good command of English and gentlemanly habits and instincts, in addition to exceptional skill and knowledge of the trade. Age between 26 and 33 years. Entering salary from $80 to $85 per month with splendid opportunity for advancement. Apply, stating age, school training and experience in detail to "K. J.," AMERICAN MACHINIST.

OHIO

Machinist. 201 Nicholas Bldg., Toledo, O.

Wanted—One machine shop foreman, acquainted with piece work. Box 547, AM. MA.

Machinists wanted in a piece-work shop; one as an inspector and one as instructor to apprentices and handymen; open shop; no labor trouble of any description; age and experience. Box 563, AMERICAN MACHINIST.

Wanted—Thoroughly first-class machine-tool designer. Preference given to one now employed. State experience, where now employed, nationality, age, whether married or single and wages expected. All communications strictly confidential. Box 530, AMERICAN MACHINIST.

Wanted—Mechanical engineer; one who can take charge of drafting and designing machine tools. Must have extended experience along these lines. Must give recommendations and state former employers and salary received and wanted. Address "Machine Tool," AMERICAN MACHINIST.

Supervisor of labor for factory employing 500 men. Line, machine tools. Must be specially qualified to handle all matters pertaining to the employment and efficiency of labor. State age and education and give full particulars regarding experience, especially during the last five years. Box 541, AMER. MACHINIST.

Tool Designer—Want an experienced designer of jigs and fixtures and automatic machinery. Must be a practical toolmaker, having worked at the bench making tools, as well as at the board designing them. Salary, $1300.00. State age and experience in full in first letter. Address J. J. Munsell, National Cash Register Co., Dayton, O.

Foreman—Man to take charge of tool-room work (20) men, which consists of general repairs, renewals, jigs and metal patterns, for large manufacturer medium line of heavy machinery. Must have held similar position of responsibility and be able to refer to results in former position. Apply by letter only, giving full details. Confidential. The Hill Clutch Co., Cleveland, Ohio.

Wanted—Firrt-class machinists, lathe, planer, drill-press, screw-machine, boring and milling-machine operators, die-sinkers and pattern-makers who are seeking positions or desirous of improving on those which they have,—to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address "Commissioner's Office," No 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Machinists wanted. Lathe, boring mill and floor hands, air compressor work. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—First-class draftsman, experienced in engine and electrical machinery drawing. Ridgway Dynamo & Engine Company, Ridgway, Pa.

Designer and draftsman on general machinery. A first-class designer capable of taking charge of work. Also one draftsman wanted. Box 447, AMERICAN MACHINIST.

Wanted—One foreman for night turn on small grinders and Lo-swing lathes. Reply, stating experience and wages desired. Box 550, AMERICAN MACHINIST.

Wanted—First-class die and toolmaker; steady position for competent man; state age, references, experience and salary expected. "C. C. C.," Box 560, AM. MACH.

Wanted—Two foremen for crank shaft department of large manufacturing establishment; none but result bringers need apply. Reply, stating experience and wages desired. Box 551, AMERICAN MACHINIST.

Wanted—One up-to-date foreman on Jones & Lamson, Potter & Johnston and Gisholt machines. One accustomed to producing results. Reply, stating experience and wages desired. Box 552, AMERICAN MACHINIST.

Wanted—Experienced foreman for gear cutting department. One thoroughly acquainted with Fellows gear shapers and Gleason generators. Reply, stating experience and wages desired. Box 549, AMER. MACH.

Wanted—Designer of extensive experience on typewriter and adding machine mechanism. Shop training and a knowledge of manufacturing methods essential. Only first-class man need apply, stating particulars in full, and salary desired. Box 546, AMERICAN MACHINIST.

Foreman in Pittsburg jobbing shop; dies and metal specialties; all-round man, systematic, good executive; man good on deep drawn work preferred; give age, references and detailed account of experience; good position and future for the right man. Box 567, AMERICAN MACHINIST.

Wanted—General superintendent. A man with wide experience and up-to-date methods in general machine shop and foundry practice, to take charge of a shop employing about five hundred men, engaged in the building of heavy machinery. All correspondence will be treated strictly confidential. In writing give references, experience and age. Box 464, AM. MACH.

Wanted—A good live agent in every shop or factory in the U. S. to sell one of the best known preparations for removing grease and grime from the hands without injury to the skin. Absolutely guaranteed. An agent can make from $5.00 to $25.00 over and above his regular salary. This is no fake. Write for free sample and agents' terms. The Klenzola Co., Erie, Pa.

WISCONSIN

Wanted—Good mechanical designers and detail draftsmen for machinery manufacturer located in Wisconsin. Box 564, AM. MACH.

Superintendent for a growing machine-tool shop now employing about 125 men. Must be a good organizer, capable of speeding output without causing quality to suffer. Reply in detail as to experience, references and salary expected. Box 534, AMERICAN MACHINIST.

# For Sale

For Sale—100 cold-rolled disks, 3⅝ inches in diameter, 3 inches long; cheap. Address Bauer Machine Co., Jeffersonville, Ind.

Purchaser for No. 2 Farwell milling machine, Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 508, AMERICAN MACHINIST.

For Sale—One 8-inch back-geared precision lathe (Rivett); in absolute perfect condition, having only been run about four days; cost $500; first reasonable offer gets the lathe. Address S. J. Yancey, Care Bibb Manufacturing Co., Porterdale, Ga.

# Alphabetical Index to Advertisers


| | PAGE |
|---|---|
| Acme Machinery Co. | 119 |
| Adams Co. | 107 |
| Advance Machinery Co. | 94 |
| Albro-Ciem Elevator Co. | 108 |
| Almond Mfg. Co., T. R. | 104 |
| American Emery Wheel Wks. | 109 |
| American Gas Furnace Co. | 113 |
| American Pulley Co. | 103 |
| American Saw Mill Machinery Co. | 103 |
| American School of Correspondence | 95 |
| American Swiss File and Tool Co. | 3d cover |
| American Tinol Co. | 114 |
| American Tool and Machine Co. | 116 |
| American Tool Works Co. | 8 |
| American Tube and Stamping Co. | 127 |
| American Wood Working Machinery Co. | 101 |
| Ames & Co., B. C. | 93 |
| Armstrong-Blum Mfg. Co. | 105 |
| Armstrong Bros. Tool Co. | 121 |
| Atlas Machine Co. | 117 |
| Automatic Machine Co. | 75 |
| Baker Bros. | 116 |
| Barnes Co., Wallace | 101 |
| Barnes Co., W. F. & John | 14 |
| Barnett Co., G. & H. | 50 |
| Bath Grinder Co. | 83 |
| Baush Machine Tool Co. | 25 |
| Bay State Stamping Co. | 101 |
| Beaman & Smith Co. | 15 and 104 |
| Becker Milling Machine Co. | 23 |
| Bemis & Call Hardware and Tool Co. | 96 |
| Besly & Co., Chas. H. | 120 |
| Bethlehem Fdry. & Mach. Co. | 117 |
| Bignall & Keeler Mfg. Co. | 100 |
| Bilgram Machine Wks. | 106 |
| Billings & Spencer Co. | 101 |
| Blaisdell Machinery Co. | 100 |
| Blanchard Machine Co. | 97 |
| Bliss Co., E. W. | 32 |
| Blount Co., J. G. | 109 |
| Boker & Co., Hermann | 81 |
| Boston Gear Works | 106 |
| Bradford Machine Tool Co. | 5 |
| Bradley & Son, C. C. | 114 |
| Bristol Co. | 4th cover |
| Brown & Co., R. H. | 104 |
| Brown & Sharpe Mfg. Co., 71 and 4th cover | |
| Browning & Co., Victor R. | 102 |
| Brubaker & Bros., W. L. | 94 |
| Buffalo Fdry. & Machine Co. | 95 |
| Bullard Machine Tool Co. | 49 |
| Butterfield & Co. | 94 |
| Caldwell & Son Co., H. W. | 108 |
| Carborundum Co. | 24 |
| Card Mfg. Co., S. W. | 16 |
| Carpenter Tap & Die Co., J. M. | 117 |
| Carter & Hakes Machine Co. | 103 |
| Carver File Co. | 101 |
| Chambersburg Engineering Co. | 117 |
| Champion Tool Works Co. | 94 |
| Chicago Flexible Shaft Co. | 112 |
| Chicago House Wrecking Co. | 91 |
| Chicago Machine Tool Co. | 96 |
| Chicago Raw Hide Mfg. Co. | 106 |
| Cincinnati Bickford Tool Co. | 10 |
| Cincinnati Electrical Tool Co. | 100 |
| Cincinnati Gear Co. | 106 |
| Cincinnati Gear Cutting Machine Co. | 128 |
| Cincinnati Lathe & Tool Co. | 95 |
| Cincinnati Milling Machine Co. | 6 and 7 |
| Cincinnati Planer Co. | 14 |
| Cincinnati Shaper Co. | 128 |
| Clark Cast Steel Cement Co. | 112 |
| Clayton Air Compressor Wks. | 100 |
| Cleveland Auto. Mach. Co. | 18 |
| Cleveland Crane & Engineering Co. | 102 |
| Cleveland Planer Works | 96 |
| Cleveland Twist Drill Co., 4th cover | |
| Clough, R. M. | 108 |
| Clum & Atkinson | 111 |
| Coates Clipper Mfg. Co. | 109 |
| Coes Wrench Co. | 26 |
| Colburn Machine Tool Co. | 34 |
| Consolidated Press and Tool Co. | 119 |
| Cook Co., Asa S. | 95 |
| Crocker-Wheeler Co. | 99 |
| Crosby Steam Gage & Valve Co. | 17 |
| Cumberland Steel Co. | 94 |
| Curtis & Curtis Co. | 100 |
| Cushman Chuck Co. | 105 |
| Cushman Electric Co. | 100 |
| Davis-Bournonville Co. | 111 |
| Davis Machine Co., W. P. | 96 |
| Defiance Machine Wks. | 117 |
| Detrick & Harvey Mach. Co. | 95 |
| Diamond Chain & Mfg. Co. | 96 |
| Diamond Machine Co. | 33 |
| Dickinson, Thos. L. | 50 |
| Dill Slotter People | 116 |
| Dixon Crucible Co., Jos. | 97 |
| Dorman, John H. | 96 |
| Dreses Machine Tool Co. | 9 |
| Earle Gear & Mach. Co. | 108 |
| Eastern Machinery Co. | 102 |
| Eck Dynamo & Motor Co. | 100 |
| Electric Welding Products Co. | 111 |
| Electro Dynamic Co. | 99 |
| Elmes Engineering Works, Chas. F. | 94 |
| Errington, F. A. | 105 |
| Evans Friction Cone Co. | 102 |
| Excelsior Needle Co. | 118 |
| Farrel Fdry. & Mach. Co. | 111 |
| Fawcus Machine Co. | 108 |

PAGE

Fay & Scott..... 50
Fay Machine Tool Co.....123
Fellows Gear Shaper Co..... 22
Felton, Sibley & Co..... 95
Ferracute Machine Co..... 95
Firth-Sterling Steel Co.....113
Fitchburg Machine Works....118
Flather Mfg. Co., E. J.....108
Flather Planer Co., Mark.... 96
Foote-Burt Co.....101
Fort Wayne Electric Wks.... 98
Fortuna Machine Co..... 99
Fosdick Machine Tool Co.... 16
Foster Machine Co..... 93
Franklin Mfg. Co.....110

Gang Co., Wm. E..... 17
Gardner Machine Co.....109
Garwood Electric Co..... 99
Gem Mfg. Co.....118
General Electric Co..... 98
Geometric Tool Co..... 27
Gisholt Machine Co.....110
Gorton Machine Co., Geo....118
Gould & Eberhardt.....120
Graham Mfg. Co.....103
Grant Gear Works.....106
Grant Mfg. & Mach. Co.....119
Graton & Knight Mfg. Co.... 94
Gray Co., G. A..... 28
Greaves, Klusman & Co.....119
Greene, Tweed & Co.....116
Gronkvist Drill Chuck Co....105

Hammacher, Schlemmer & Co. 77
Hardinge Bros..... 95
Harrington, Son & Co., Edw..121
Hart & Cooley Co.....124
Hendey Machine Co..... 79
Henry & Wright Mfg. Co.....115
Hess-Bright Mfg. Co.....125
Hisey-Wolf Machine Co..... 98
Hoefer Mfg. Co..... 34
Hoggson & Pettis Mfg. Co...104
Horsburgh & Scott Co.....108
Horton & Son Co., E.....104
Hoskins Mfg. Co.....112
Huribut Rogers Machine Co.. 96

Independent Pneumatic Tool Co.....100
Industrial Oxygen Co.....112
Ingersoll Milling Machine Co.114
International Acheson Graphite Co.....127
International Correspondence Schools..... 96

Jacobs Mfg. Co.....105
Jefferson Union Co.....118
Johnson Machine Co., Carlyle.121
Jones & Lamson Mach. Co., 12, 13 and 50

Kearney & Trecker Co..... 26
Kelly Co., R. A.....105
Kempsmith Mfg. Co..... 22
Kern Machine Tool Co.....117
Keuffel & Esser Co..... 85

PAGE

Knight Machinery Co., W. B. 97

Landis Machine Co.....116
Landis Tool Co..... 73
Lapointe Machine Tool Co... 92
Lea Equipment Co.....117
LeBlond Machine Tool Co., R. K.....1 and 4th cover
Lincoln-Williams Twist Drill Co.....119
Link-Belt Co.....115
Lodge & Shipley Machine Tool Co..... 4
Long & Allstatter Co.....114
Lucas Machine Tool Co..... 93
Lumen Bearing Co.....114
Lyon Metallic Mfg. Co.....110

Manning, Maxwell & Moore, Inc.....127
Manufacturing Equipment and Engineering Co.....122
Manville Bros. Co..... 94
Manville Machine Co., E. J..110
Maris Bros.....102
Marshall & Huschart Mch. Co. 91
Massachusetts Saw Works... 92
McCabe, J. J.....34 and 90
McCabe Machine Co..... 92
McGraw-Hill Book Co..... 87
Merritt, Jos..... 50
Mitts & Merrill.....114
Modern Machinery Co..... 94
Modern Tool Co..... 92
Moore & White Co.....103
Morris Fdry. Co., John B....124
Morrow Mfg. Co.....104
Morse Chain Co.....123
Morse Twist Drill and Mach. Co..... 75
Morse, Williams & Co.....107
Morton Mfg. Co..... 95
Motch & Merryweather Machinery Co..... 90
Mueller Machine Tool Co....103

National-Acme Mfg. Co.....128
National File and Tool Co...123
National Machinery Co..... 94
National Tube Co.....111
New Britain Machine Co....108
New Haven Mfg. Co.....120
New Process Raw Hide Co...107
Newark Gear Cutting Machine Co.....108
Newton Machine Tool Wks... 11
Niagara Machine Tool Works Co..... 92
Nicholson & Co., W. H..... 97
Nicholson File Co..... 17
Niles-Bement-Pond Co., 2 and 35 to 42, 48 and 91
Nolte Brass Co.....114
Northern Engineering Wks...102
Norton Co..... 89
Norton Grinding Co..... 88
Nuttall Co., R. D.....106

Obermayer Co., S.....111

PAGE

Oesterlein Machine Co.....128
O. K. Tool Holder Co..... 94
Osgood, J. L..... 94

Page-Storms Drop Forge Co.. 93
Parker Co., Chas.....101
Patterson, Gottfried & Hunter.103
Pawling & Harnischfeger....102
Paxson Co., J. W.....111
Pearce Co., Fred'k.....117
Philadelphia Gear Works....106
Potter & Johnston Mach. Co., 20 and 21
Pratt & Whitney Co., 3 and 43 to 47
Pratt Chuck Co.....104
Pratt Institute..... 95
Prentice & Co., Inc., Geo. G. 31
Prentice Bros. Co..... 29
Prentiss Tool & Supply Co... 90

Quride Co.....108

Ransom Mfg. Co.....109
Ready Tool Co..... 97
Reed Co., F. E..... 79
Reed Mfg. Co.....103
Reeves Pulley Co.....102
Risdon Tool Works..... 97
Rivett Lathe Mfg. Co...3d cover
Robertson Drill & Tool Co...125
Rockford Drilling Mach. Co.. 85
Rockwood Mfg. Co.....102
Rogers & Hubbard Co.....111
Root Co., C. J.....100
Roth Bros. & Co.....100
Rowbottom Machine Co..... 94

Safety Emery Wheel Co.....109
Sanford Mfg. Co., F. C.....111
Saunders Sons, D.....114
Sawyer Gear Works.....106
Schieren Co., Chas. A.....118
Schuchardt & Schutte.....110
Schumacher & Boye..... 9
Sebastian Lathe Co..... 32
Sellers & Co., Inc., Wm..... 30
Seneca Falls Mfg. Co.....121
Shaw Electric Crane Co.....102
Shepard Electric Crane and Hoist Co.....103
Shultz Belting Co.....102
Sibley Mach. Tool Co.....115
Simonds Mfg. Co.....101
Simplex Mfg. Co..... 95
Skinner Chuck Co.....104
Slack Manufacturing Co.....124
Slate Machine Co., Dwight...122
Sloan & Chace Mfg. Co..... 77
Slocomb Co., J. T..... 97
Smith & Mills..... 96
Smith Co., Wm. J.....102
Smith Countershaft Co.....120
Smooth-On Mfg. Co.....111
Spacke Mach. Co., F. W.....100
Springfield Machine Tool Co.. 15
Standard Connecting Rod Co.118
Standard Engineering Wks... 94
Standard Gauge Steel Co....118

PAGE

Standard Tool Co..... 83
Standard Welding Co.....122
Stark Tool Co..... 96
Starrett Co., L. S..... 88
Steptoe Shaper Co., John....116
Stoever Fdry. & Mfg. Co..... 95
Sturtevant Co., B. F..... 31

Tabor Mfg. Co.....114
Taylor & Fenn Co.....119
Taylor-Wilson Mfg. Co.....108
Toledo Electric Welding Co..111
Toomey, Frank..... 91
Townsend Mfg. Co., H. P.... 97
Triumph Electric Co..... 99
Trump Bros. Machine Co....105

Underwood & Co., H. B..... 94
Union Mfg. Co.....104
Union Twist Drill Co..... 73
United Engineering & Fdry. Co.....126
Universal Boring Machine Co. 96
Universal Electric Welding Co.....111
Universal Machine Screw Co.124
U. S. Electric Tool Co.....100
Utica Drop Forge & Tool Co.. 32

Van Dorn & Dutton Co.....108
Van Dorn Elec. & Mfg. Co...100
Vandyck Churchill Co.....115
Veeder Mfg. Co.....119
Vitrified Wheel Co.....109
Von Wyck Mach. Tool Co.... 92

Wade Machine Co.....100
Walcott & Wood Mach. Tool Co..... 95
Walker & Co., O. S....4th cover
Waltham Watch Tool Co.... 95
Walton Co., The..... 96
Walworth Mfg. Co..... 50
Ward & Sons, Edgar T.....112
Warner & Swasey Co..... 28
Warner Instrument Co.....116
Watson-Stillman Co..... 98
Wells Bros. Co..... 95
Western Electric Co..... 98
Western Machine Tool Wks. 96
West Haven Mfg. Co..... 93
Wheeling Mold and Foundry Co..... 95
Whitcomb-Blaisdell Machine Tool Co..... 19
Whitman & Barnes Mfg. Co.. 89
Whitney Mfg. Co..... 69
Whiton Machine Co., D. E...105
Wiley & Russell Mfg. Co.....116
Williams & Co., J. H.....126
Wilmarth & Morman Co.....109
Windsor Machine Co..... 27
Wood Turret Machine Co.... 96
Woodward & Powell Planer Co.....119
Worcester Machine Screw Co. 94
Wormer Machinery Co., C. C. 92

Yale & Towne Mfg. Co.....102


# Classified Index to Articles Advertised


**Abrasive Materials**

Abrasive Material Co., Phila., Pa.
American Emery Wheel Co., Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Dickinson, Thos. L., New York.
Norton Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

**Accumulators, Hydraulic**

Chambersburg Engineering Co., Chambersburg, Pa.
Watson-Stillman Co., New York.

**Air Lifts**

Ingersoll-Rand Co., New York.

**Alundum**

*See Grinding Wheels.*

**Arbor Presses**

Barnes Co., W. F. & John, Rockford, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

**Arbors**

Cleveland Twist Drill Co., Cleveland, O.
Cochrane-Bly Co., Rochester, N. Y.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.

**Arbors**—*Continued.*

Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn.
Union Twist Drill Co., Athol, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

**Balls, Steel**

Boker & Co., Hermann, New York.

**Barrels, Steel**

Lyon Metallic Mfg. Co., Aurora, Ill.

**Bars, Boring**

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Krieger Tool & Mfg. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Underwood Co., H. B., Philadelphia, Pa.

**Bearings, Ball and Roller**

Boston Gear Works, Norfolk Downs, Mass.
Hess-Bright Mfg. Co., Philadelphia, Pa.
Hyatt Roller Bearing Co., Harrison, N. J.

**Belt Clamps**

Hoggson & Pettis Mfg. Co., New Haven, Conn.

**Belt Dressing**

Cling-Surface Co., Buffalo, N. Y.

**Belt Dressing**—*Continued.*

Dixon Crucible Co., Joseph, Jersey City, N. J.
Graton & Knight Mfg. Co., Worcester, Mass.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Smooth-On Mfg. Co., Jersey City, N. J.

**Belt Fasteners**

Bristol Co., Waterbury, Conn.
Greene, Tweed & Co., New York.

**Belt Filler**

Cling-Surface Co., Buffalo, N. Y.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Smooth-On Mfg. Co., Jersey City, N. J.

**Belt Lacing Machines**

Birdsboro Steel Foundry & Mach. Co., Birdsboro, Pa.

**Belt Shifter**

The L. & D. Co., Boston, Mass.

**Belting, Chain**

Link Belt Co., Phila., Pa.

**Belting, Leather**

Chicago Raw Hide Mfg. Co., Chicago, Ill.
Graton & Knight Mfg. Co., Worcester, Mass.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

**Benches, Work**

Manufacturing Equipment & Engineering Co., Boston, Mass.

**Bending Machinery, Hydraulic**

Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Phila., Pa.

**Bending Machines, Plate**

Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

**Bending Machines, Power**

Bethlehem Fdry. & Machine Co., South Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

**Blanks, Nuts and Screw**

Electric Welding Products Co. Cleveland, Ohio.

**Blocks, Chain**

*See Hoists, Hand.*

**Blocks, Die**

Nicholson & Co., W. H., Wilkes-Barre, Pa.